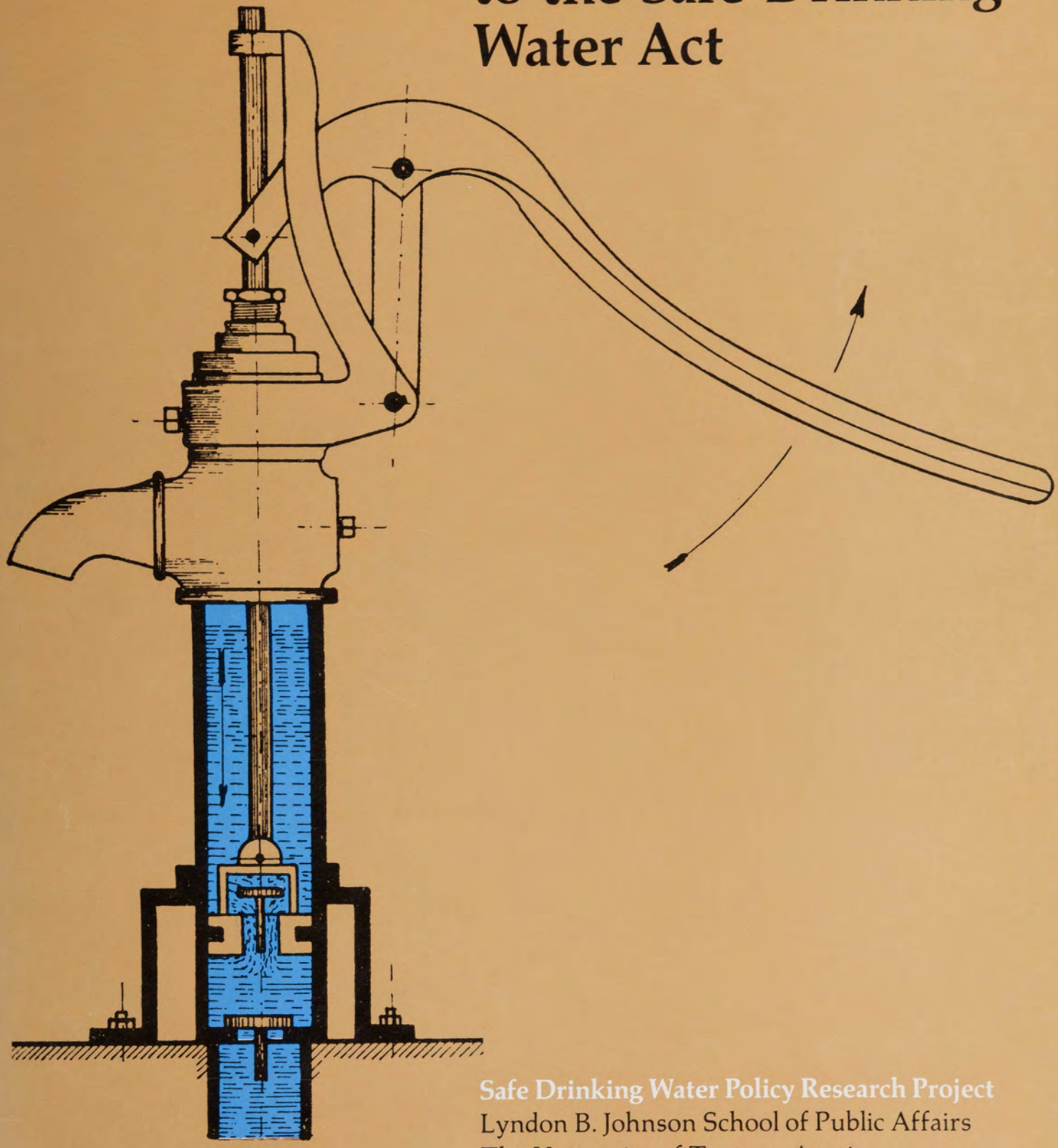
Options for Community Response to the Safe Drinking Water Act



Safe Drinking Water Policy Research Project
Lyndon B. Johnson School of Public Affairs
The University of Texas at Austin

Lyndon B. Johnson School of Public Affairs
Policy Research Project Report
Number 35

OPTIONS FOR COMMUNITY RESPONSE TO THE SAFE DRINKING WATER ACT

A Report by
The 1978 Safe Drinking Water Policy Research Project
Lyndon B. Johnson School of Public Affairs
The University of Texas at Austin
1979

Library of Congress Card Number: 79-90646
ISBN 0-89940-635-1

FOREWORD

The Lyndon B. Johnson School of Public Affairs has established interdisciplinary research on policy problems as the core of its educational program. A major part of this program is the nine-month policy research project, in the course of which two or three faculty members from different disciplines direct the research of ten to twenty graduate students of diverse backgrounds on a policy issue of concern to an agency of government. This "client orientation" brings the students face to face with administrators, legislators, and other officials active in the policy process, and demonstrates that research in a policy environment demands special talents. It also illuminates the occasional difficulties of relating research findings to the world of political realities.

This report is the outgrowth of a policy research project conducted at the School during the 1977-78 academic year. The study, funded in part by the Environmental Protection Agency, and the Ford Foundation examined issues of community response to implementation of the Safe Drinking Water Act. Students and faculty prepared briefing papers, which are presented in this report, on water provider options to cope with the legal, administrative, economic, and engineering implications of the Act.

It is the intention of the LBJ School both to develop men and women with the capacity to perform effectively in public service and to produce research which will enlighten and inform those already engaged in the policy process. The project which resulted in this report has helped to accomplish the former; it is our hope and expectation that the report itself will contribute to the latter.

Elspeth Rostow
Dean

ACKNOWLEDGMENTS

The Policy Research Project members express appreciation to all who contributed to the preparation of this report. Both the Region VI office of the U.S. Environmental Protection Agency and the Ford Foundation provided funding for the Policy Research Project study. Staff members (too numerous to mention by name) of the Texas Department of Health, Texas Department of Water Resources, Texas Water Development Board, Texas Department of Community Affairs, U.S. Environmental Protection Agency, Economic Development Administration, Farmers Home Administration, Department of Housing and Urban Development, and Texas League of Women Voters gave freely of their time, data, and ideas.

We are also grateful to Laura Eisenhour who designed many of the graphics in the report, Nancy Whittington who illustrated the cover, and Barbara K. Kulsrud who assisted in proofreading the text. Mr. James Roy, Mr. Charles Chandler, and the drinking water program staff of the Region VI Environmental Protection Agency provided valuable assistance by reviewing the final draft of the text.

POLICY RESEARCH PROJECT PARTICIPANTS

Students

Curt A. Christeson
Pablo Collins
Richard F. Gowen
Crespin Guzman
Russell K. Hedge, Jr.
Larry J. Junek
Barbara K. Kulsrud
David N. Osborn
Betty Rogers
Aileen C. Whitfill

Faculty

David Eaton, Ph.D
Gerald A. Rohlich, Ph.D
R. Barry Lovelace

TABLE OF CONTENTS

EXECUTIVE SUMMARY

INTRODUCTION

During 1976-77, a group of faculty and students at the LBJ School of Public Affairs conducted a study on the impacts of the Safe Drinking Water Act (hereafter referred to as the Act) on water suppliers in Texas. This research concluded that there is some uncertainty as to whether small suppliers can meet the federal limitations to the concentration of flourides and nitrates present in community drinking water supplies. As a result of that 1976-77 project, faculty at the LBJ School proposed to the Region VI office of the U.S. Environmental Protection Agency (EPA) that they support the preparation of briefing papers on water provider options to cope with the legal, administrative, economic, and engineering implications of the Act.

This volume contains the briefing papers developed by project members during 1977-78. Chapter one, written by David J. Eaton, provides an overview of the impact of the Act on Texas community water systems. Barbara Kulsrud wrote chapter two which reviews the National Academy of Sciences' report on *Drinking Water and Health.* The third chapter, by Betty Rogers, is concerned with communicating information on the Act to water system personnel and consumers. Curt A. Christeson and Crespin Guzman reviewed the characteristics and costs of engineering processes for removing fluoride and nitrate from drinking water in chapter four. In chapter five, Larry J. Junek and Aileen C. Whitfill developed a guide for small water systems on the alternate federal and Texas sources of financial aid. The final chapter, by Russell K. Hedge, collects information regarding the legal, administrative, financial, and political issues associated with the regionalization of water supplies through cooperative service arrangements. The arguments contained in these chapters are summarized in the following sections.

CHAPTER ONE:

OPTIONS FOR COPING WITH THE SAFE DRINKING WATER ACT

This chapter explores the problems of moving from the passage of the Safe Drinking Water Act to the implementation of the Act. Implementation problems arise because there are differences in perception between those who decide and those who carry out the Act. Those who decide include the U.S. Congress, which passed the laws; the U.S. Environmental Protection Agency, which has promulgated standards; and the states, which in most cases will accept a primary role in implementing the Act. However, ultimate responsibility for improving drinking water rests upon local water utilities and their customers who pay the bills.

Definition of Agency Roles

One implementation issue is that the roles of different agencies and the rules they will follow are uncertain. The mandates of three federal agencies: the EPA, the Food and Drug Administration (FDA), and the Farmers Home Administration (FmHA) appear to overlap. The EPA has the responsibility under law to administer the Safe Drinking Water Act. The FDA is charged with assuring "safe" water for the preparation and processing of food and drugs. The FmHA administers a grant and loan program to assist in the construction of rural water supply systems. Because regulatory actions by each of these agencies can affect community water supplies, it is clear that all involved would benefit if the agencies would adopt a common basis for judging the fitness of community water supply systems.

A second role problem, particularly in Texas, is the complexity of the variance and exemption process. Because there are 573 suppliers in Texas with drinking water that exceeds at least one maximum contaminant level (MCL), the Texas Department of Health could face many hearings to administer variances and exemptions. One alternative to a system of hearings for individual suppliers could be hearings by classes of suppliers. However, the Texas Department of Health and the EPA have yet to agree on a meaning for a "class" of suppliers.

Water systems grouped as to geographical propinquity might not share identical contaminant problems. Suppliers grouped on a "severity of contaminant" basis might differ substantially in terms of alternate sources of water or the prospects for cooperation with nearby suppliers with similar problems. Neither of these schemes takes account of system size, even though size is a prime determinant of the ability of a system to finance improvements.

Impact on Small Systems

A second implementation issue concerns the possible harsh consequences for small water suppliers currently in non-compliance with the Act's requirements. Of 550 community water systems in Texas with drinking water that exceeds either the fluoride or the nitrate MCLs, 191 supply fewer than 100 persons. Another 177 systems serve 100-500 persons.

The small suppliers may have neither the will nor the means to treat their water to remove fluoride and nitrate contaminants. When interviewed, water system personnel were resistant to the idea of voluntary compliance. Of 63 water suppliers not in current compliance, more than half did not believe that their systems' water is a health risk or that improving their water to meet federal standards should be a local responsibility. Although numerous federal and state programs exist to provide aid to communities for water supply improvements, the FmHA is the only agency likely to aid those small communities.

Even if small systems were eager to reduce nitrate and fluoride contaminants and sufficient funds existed, there is some uncertainty whether small public systems have the operator talent necessary to manage sophisticated treatment plants. Many systems operators work part-time, without pay, and have been trained only to treat water with chlorine.

Privately owned suppliers, such as the water systems of trailer parks, are as liable as other systems to the provisions of the Act. However, unlike public systems which can spread cost liability among consumers via water rates, mobile home park owners bear sole liability for costs. The owner may attempt to pass on a portion of these costs to consumers, but users can refuse to pay by moving elsewhere. Such costs put a private park owner at a disadvantage to its competitors.

There is an expectation gap between the federal government and small public systems with respect to compliance. Local systems do not feel willing or able to finance by themselves the necessary improvements to reduce fluoride or nitrate contaminants. The federal government has resolved that improvements in water supplies shall be financed by the local public utility. It is clear that the EPA and the State of Texas will have to work with affected communities over a reasonable time period to achieve compliance.

The Balance of Risks and Benefits

A third implementation issue relates to the ambiguity of the term "safe water" and the balance between risks and costs. It is difficult to directly state that water is or is not safe. Scientists prefer to evaluate the level of risk, or the association between a water contaminant and ill health. A decision on a water MCL reflects a value judgment about some "socially acceptable level of risk."

Any drinking water regulation program needs to build a professional and public consensus that can legitimize continuing water system improvements. Under any set of standards, there would be disagreement as to whether the costs of compliance balance the reduced health risks. Because some scientists question whether the standards for chlor-organics and fluoride contaminants in water are too restrictive, the EPA should further explore the relation between (a) chlor-organics and cancer, and (b) fluorides and ill health to provide a stronger base of information.

Suppliers Not Subject to Jurisdiction

A final implementation issue concerns the Act's failure to address the fate of water suppliers too small to be subject to its jurisdiction. The Act requires that all piped water systems with at least fifteen service connections (or twenty-five customers) comply with federal drinking water standards. However, water providers with no piped distribution systems such as the *colonias* of the lower Rio Grande Valley in Texas, may not be subject to the Act. These rural unincorporated communities have rather primitive water and waste disposal systems and relatively high rates of those diseases spread by water-borne fecal contamination. Such diseases could be reduced by treating drinking water. Amendments to the Act should find some way to bring such systems under its review.

A Strategy for Implementation

The response of the EPA and the Texas Department of Health to the ambiguities of enforcing the Act should be a stance of "cooperation, cooptation, and conversion" toward local water suppliers. Enforcement programs should provide a reasonable amount of time, technical assistance, and on occasion some financial aid to assist small community water systems to meet the goals of the Act.

CHAPTER TWO:

SETTING NATIONAL SAFE DRINKING WATER STANDARDS

This chapter reviews the major issues and findings of the National Academy of Sciences (NAS) Committee on Safe Drinking Water. Sections in the chapter examine (a) techniques for determining human risk associated with ingestion of contaminants in drinking water; (b) the different classes of substances found in drinking water; and (c) the NAS Committee's findings on health problems associated with such contaminants.

Determining Risk and Safety

To assess the possible risks to man from ingestion of dissolved substances and particulates in drinking water, research workers study health patterns in human populations (epidemiology) and experimental data from laboratory tests on cells or animals (toxicology). Neither approach provides an easy or reliable means to calculate explicit risks of drinking water contaminants to human populations. Toxicological studies are valuable because they can suggest a relationship between an individual pollutant and a health effect in a subject animal species. Such studies may suggest a risk of the substance to humans, although extrapolation to humans is complicated by many factors. Epidemiological studies are valuable in that they can illustrate disease patterns and help to amplify or contradict data from laboratory research. Due to the many complications of each kind of study, the NAS Committee concluded that it is more appropriate to specify "the doses exhibiting no observed adverse affect," rather than to try to determine safe levels for contaminants. For estimating risk to man from contaminants shown to be carcinogenic in laboratory animals, the NAS Committee adopted a "non-threshold" assumption; this approach states that if a substance can cause cancer, then there exists no dose below which harmful responses would not occur. The Committee also pointed out that the risks of a pollutant must be weighed against its benefits before making a final determination regarding an acceptable level in drinking water.

Contaminants in Drinking Water

The NAS Committee identified five classes of materials which can be considered drinking water contaminants: microbiological life, solid particles in suspension, inorganic solutes, organic solutes, and radioactivity. Each of these materials can affect humans in different ways.

Microbiological contaminants in water include bacteria, viruses, protozoa, fungi, and algae. Bacteria, viruses, and pathogenic protozoa in drinking water can and do cause ill health. Fungi and algae do not appear to be major causes of water-borne disease, although they can produce unpleasant tastes and odors in water.

Particles which do not dissolve in water may be organic or inorganic, for example, clays or fibrous particles of abestos. Human activities or natural processes can contribute such insoluble particles. Information is sparse on the health effects resulting from ingestion of water containing suspended solids. Clay or natural organic particulates may present a health hazard if they absorb, transport, and release inorganic and organic toxicants, bacteria, or viruses. Some asbestos fibers are known cancer-causing substances when inhaled, and there is some concern that asbestos mineral fibers in water may also present a health hazard.

Inorganic solutes refer to trace metals or metallic elements dissolved in drinking water by either physical processes or human activities. Adverse health effects are related to the total intake of inorganics from water, air, and food. Some of the trace metals, such as chromium, cobalt, copper, magnesium, manganese, molybdenum, tin, and zinc, are essential human nutrients. Others, including lead, mercury, and cadmium, are not believed to be essential human nutrients and can be dangerous. All trace metals are known to show harmful effects at some intake level.

The most prevalent inorganic solute problems in Texas are caused by excess fluoride or nitrate contaminants in groundwater. High concentrations of nitrates in drinking water have been implicated in the induction of methemoglobinemia (an infant blood disorder) and the possible formation of nitrosamines (possible cancer causing agents). Fluoride is found in many water supplies, although usually in low concentrations. Small amounts of fluoride, about one milligram per liter, are considered to be beneficial in reducing the incidence of dental cavities in children. However, long-term ingestion of fluoride in excessive levels can cause dental fluorosis, ranging from mottling of tooth enamel to severe surface corrugations. At fluoride intakes of ten to twenty milligrams per day over long periods of time, skeletal fluorosis (increased bone density) can also occur. In addition, some researchers contend that fluoride may be a cancer-causing agent.

Some persons are particularly vulnerable to certain inorganic substances. Children are especially sensitive to excessive barium, lead, and nitrates. People deficient in zinc and cadmium (e.g., lactose-intolerant persons) can be affected by cadmium. Persons with Wilson's disease, a

disorder of copper metabolism, are sensitive to inorganic copper in drinking water.

Organic contaminants include pesticides and a variety of organic compounds such as vinyl chloride, chloroform, carbon tetrachloride, and benzene. Although substances that can be identified as "organics" are often measured in drinking water samples, only a fraction of the exact chemicals species have ever been identified. Of those identified organic compounds, there is often inadequate available information on harm to humans. A major concern regarding organic compounds in drinking water is their possible cancer-causing effects. The NAS committee concluded that sufficient data for judging either the carcinogenicity or acceptable daily intake for organic compounds existed for only three-fourths of the organic pesticides and for less than one-fourth of the non-pesticide organic compounds.

Radiation is generated both by naturally occuring radioactive elements or cosmic rays which bombard the earth from space, and from human activity (e.g., medical x-rays). Minute traces of radioactivity are commonly found in all drinking water, though usually in very low concentrations. Radiation can produce damage to genes (mutagenesis), to cells (cancer), or to offspring (teratogenesis). According to the NAS report, radiation found in drinking water is a very small proportion of the total amount of radiation to which humans are exposed. The Committee does conclude that certain concentrations of radium are associated with a higher risk of bone cancer.

Conclusions

The NAS study concluded that there are hundreds of substances present in our drinking water supplies and that the health effects of these contaminants are often unknown. In many cases, lack of information makes it impossible to estimate risk levels or a safe threshold level for substances in drinking water. Complicating factors include: (a) the variability of human responses to contaminants; (b) differences among individuals in the quantities of water consumed; and (c) the opportunities (other than drinking water) for exposure to contaminants, such as food ingestion. The NAS Committee does summarize both the existing knowledge and uncertainties on the nature and effects of contaminants in drinking water.

CHAPTER THREE:

COMMUNICATION AND THE SAFE DRINKING WATER ACT

A major issue related to the Act's implementation is the problem of communicating the provisions of the Act and its implementation requirements to a wide variety of consumers and suppliers. The Act and its regulations are rather complex and may pose problems of interpretation to those responsible for water system management. Also, the Act requires that the public, as well as those involved in water supply, be notified if a community's water supplies are above the appropriate MCL. This communication problem is particularly difficult, for some of the small Texas water systems do not employ full-time staff.

Under the Act, both state and local authorities have responsibility to notify the public about drinking water quality. Local suppliers must notify consumers and news media in the event of non-compliance or face penalties. State grants from the EPA require that 10 percent of the total budget be used for involving the public in Act implementation. Although the Act allows and encourages consumers to be the ultimate watchdogs of the entire system, a study at the LBJ School of Public Affairs in 1977 found that information could become a constraint to effective implementation of the Act. The purpose of this chapter is to evaluate methods to disseminate information regarding the Act to the public.

Methods of Information Dissemination

Of the more than 4000 existing community water suppliers in Texas, the Texas Department of Health has identified more than 550 systems with water that contains either nitrate or fluoride in excess of the appropriate MCL. One communication task is to inform each of these systems of the requirements of the Act and how it will affect them. To succeed in such an effort, it is helpful to study the methods which can be utilized.

What are some of the major means of communicating with the managers of these systems and with their consumers? One method is to communicate with key decisionmakers within the system under the assumption that they will, in turn, communicate with consumers. Another method is through broad-issue mailings directed at consumers. A third method is through the mass media, by advertising in newspaper or on radio and television. A final approach is through conducting public meetings where the provisions of the Act and its implications are explained to interested citizens.

Mass mailings have been employed by numerous state and federal agencies. This approach involves preparation of information in general, nontechnical language. Some of the outstanding examples are the "Project Safe Water"

packet developed by the Texas League of Women Voters, the "Readers on Water Quality" of the Texas Department of Water Resources, and the "Safe Drinking Water Act" (the "Blue Book") of the Texas Department of Health.

Another approach mentioned above is use of the mass media—television, newspapers or radio—to disseminate information. The Texas Department of Water Resources commonly uses the print media to disseminate news releases.

Contacting a key administrator is an effective way to reach both influential persons and a large audience. This person can pass information on to other individuals in a group, organization, town, or constituency. For example, a mailing to the members of the Texas Municipal League would reach municipal leaders of 785 cities in Texas, or 98 percent of the towns in Texas with a population of 1000 or more.

Public meetings can be a powerful way to communicate, since they involve face-to-face interaction, allow for feedback in "question and answer" sessions, and can utilize visual aids. Agencies dealing with the Act have used meetings extensively to inform the public about the Act and its consequences. Public meetings, whether they are conferences, seminars, or open hearings, have been found to be a most cost-effective form of communication, provided prior advertising is done to assure a large audience. A useful and effective example of the meeting as a mode of communication is the "short school" courses organized by the engineering extension service of the Texas A&M University System.

Proposals for Communications Campaigns

After a review of the activities of various agencies interested in safe drinking water in Texas, it is possible to suggest an approach to reach the public about the Act. A statewide campaign could begin with a mailing list which includes key persons in all communities with water systems that are not in compliance with the Act. The State could send to each key person a series of pamphlets or booklets about the Act. These should include information regarding: (a) the Act and its impact on Texas communities; (b) the meaning of non-compliance and its administrative, financial, and technical ramifications; (c) the basis for the MCL standards; and (d) a description of treatment methods, the options for gaining time (variances or exemptions), or for joining with other communities (regionalization).

To obtain a sense of community understanding and response, the State should include a stamped, pre-addressed "feedback" card. To further evaluate the effectiveness of these information packets, regional engineers could be requested to speak to systems managers regarding the impact of the material.

It is also possible to conceive of a community information campaign that a water system operator might use to explain the Act to consumers. A local campaign could utilize direct mailings, the news media, or personal contacts. Photographs, cartoons, tables, graphs, or charts could be inserted along with water bills to describe the Act and its requirements. Newspapers, radio and television, or public transportation vehicles could be used as media for distribution of information about the Act. Personal contacts by telephone calls, public speakers, public meetings, or special events can also be helpful for communicating information on the Act.

CHAPTER FOUR:

WATER TREATMENT TECHNOLOGY FOR FLUORIDE AND NITRATE REMOVAL

Some non-compliant systems may wish to reduce fluorides and nitrates in their water supplies through water treatment.* Treatment techniques exist which selectively remove fluorides or nitrates, or non-selectively remove either or both contaminants.

Reverse osmosis is a process which subjects water to a pressure greater than the natural osmotic pressure. A semipermeable membrane will allow the pure water to flow through but will not allow the passage of salt. This process can remove any dissolved constituent in the water. There have been six plants constructed since 1971 which remove total dissolved solids by reverse osmosis and another twelve are currently under construction. Removal efficiencies for total dissolved solids have ranged from 55 to 99 percent. It is estimated that reverse osmosis can non-selectively remove more than 90 percent of both nitrates and fluoride contaminants. Reverse osmosis is a complicated process, involving expensive membranes, substantial pretreatment and post-treatment of water, and complications associated with

*There exist a number of non-treatment alternatives for reducing fluorides and nitrates, such as switching from ground to surface waters or alternate groundwater sources, blending of several water sources, or purchasing finished or bottled waters.

the disposal of waste brines. Reverse osmosis works best when the feedwater is high in total dissolved solids, neither cold nor hot (optimum temperature at 25° C), and slightly acidic.

Electrodialysis is a process that also uses a semipermeable membrane to remove dissolved salts from waters. Instead of using membranes which reject dissolved solids (as in reverse osmosis), eletrodialysis membranes permit the selective passage of electrically charged salt particles. Electrodialysis has been used to non-selectively remove nitrate ions. Six plants are currently under construction which will use electrodialysis to remove total dissolved solids, with removal efficiencies ranging from 55 to 90 percent. It is estimated that the nitrate removal rate will be at least 50 percent. As with reverse osmosis, electrodialysis performance is improved by pretreatment, although electrodialysis membranes can operate at a higher feedwater temperature (43° C) and under a wider range of pH (from 6 to 9).

Ion exchange has been used to remove fluoride and nitrate ions from community water supplies. One type of ion exchange is demineralization, where inorganic ions are replaced by hydrogen and hydroxide ions. When water containing fluoride and nitrate is fed through a demineralization process, the resultant water will be low in total dissolved solids, fluoride, and nitrate.

A number of materials have been investigated for their ability to remove flouride by adsorption. Two materials, activated alumina and tricalcium phosphate (bone char), have been used successfully in full-scale operations. Activated alumina seems to be more widely accepted.

Denitrification is a process by which denitrifying bacteria reduce nitrate to nitrogen gas. Water is passed through a biological filter bed, and organisms in the biological slime use nitrate for metabolism. More research is necessary before denitrification can be routinely used for public water supplies.

Conventional lime softening can be a useful method for removing fluoride. It has been shown that substantial amounts of fluoride are removed along with magnesium during the lime softening process. The decrease in fluoride is a function of the magnesium removed.

Each of these techniques has been shown to be effective in the laboratory at removing fluoride and/or nitrate. All are complicated processes, often involving pretreatment, post-treatment, and sludge disposal. Treatment costs vary over a wide range.

This chapter should not be considered as a guide to the design of water treatment systems to remove fluoride or nitrate. Each of the processes is complex enough to warrant an engineering design prior to installation. Operating personnel will require training in order to effectively operate and maintain such systems. The authors recommend that any community attempting to reduce either fluoride or nitrate contaminants from a water supply seek professional engineering advice.

CHAPTER FIVE:

FINANCIAL ASSISTANCE FOR SAFE WATER FACILITIES

In order to comply with the Act, water suppliers may be required to initiate major capital expenditure programs. Suppliers with drinking water that contains excessive contaminants may either have to install equipment to remove the contaminants or develop alternate sources of raw water. Such investments may be beyond the financial capacity of the community. Several programs operated by the State of Texas and federal agencies can financially assist these water systems.

This chapter describes the sources of assistance for communities to improve drinking water supplies. It discusses eligibility requirements, application procedures, and decision criteria for technical aid, grants, and loans. It considers both technical and financial aid from federal, state, and regional levels of government.

Sources of State and Regional Aid

The Texas Department of Health provides in-kind aid to local water systems through provision of surveillance and laboratory analysis of water systems. The regional Councils of Government can assist communities by advising them how to apply for available state and federal aid.

The State of Texas does provide financial aid for the construction of local water projects through the Texas Department of Water Resources (TDWR). The TDWR can finance local water improvements by using the Texas Water Development Fund to purchase a community's water development bonds at an interest rate below the rate on the open market. There are no standard application forms. The TDWR can extend loans only to political subdivisions in Texas, such as counties, municipalities, and special districts.

A large community with a sound economic base is more likely to obtain aid than a small town. If a community cannot clearly demonstrate that it can repay a loan, it may not obtain support. The size of the loan depends upon the size of the project and the financial status of the community. The TDWR generally will not assist an municipality if its water supply system indebtedness exceeds 25 percent of the assessed property

value. The Board will rarely extend a loan to a special district for an amount greater than 10 percent of the assessed value of real property.

Sources of Federal Aid

Several federal programs provide aid to communities for water supply improvements. The EPA may provide limited technical assistance to communities that do not currently comply with the drinking water quality standards. The Economic Development Administration (EDA) in the U.S. Department of Commerce and the Department of Housing and Urban Development (HUD) give grants and loans for infrastructural improvements. While either EDA or HUD could finance water treatment or source development, safe drinking water is not a high priority with either agency. In addition, most of their aid is targeted at communities larger than those Texas towns with fluoride or nitrate problems.

The Farmer's Home Administration (FmHA), an agency within the U.S. Department of Agriculture, provides credit for rural communities that are unable to obtain credit from other sources at reasonable terms and rates. Both loans and grants are available to aid in water systems development or improvement. To obtain funds, a community should apply for either (a) a community facility loan or (b) a grant for up to 50 percent of project development costs. The FmHA is authorized to make loans or grants to develop rural community facilities for public use in areas with fewer than ten thousand residents when sufficient need can be demonstrated. Loans are available to municipalities, counties, other political subdivisions, or nonprofit corporations.

Of all the agencies, the FmHA is the most receptive to water system improvement proposals from small rural communities. For most local water systems, however, increased water rates are likely to be the major source of revenue for improvements related to implementation of the Act. It is possible for a community to obtain joint funding from a combination of agencies. For example, the TDWR has loaned funds to a community to match federal grant requirements.

CHAPTER SIX:

COOPERATIVE SERVICE ARRANGEMENTS FOR COMMUNITY WATER SYSTEMS

Texas water law establishes a community's right to decide the manner in which it will supply water to residents. In the past, many communities have chosen to maintain independent water supply and distribution systems. However, economic and political considerations may prompt the consideration of nontraditional institutional arrangements. Cooperative water supply arrangements may provide a means for checking the rising cost of water service and minimizing any added expenses associated with achieving federal drinking water quality standards. The paper reviews some of the issues that may confront a water system wishing to exercise its rights to enter into such a cooperative water supply arrangement.

Water Supply Arrangements

The paper first presents the five basic institutional forms of water supply systems serving Texas: municipal water systems, water districts, river authorities, private profit-making water systems, and nonprofit water supply corporations. These basic institutional entities are distinguished by different administrative structures and requirements.

When the population of a community reaches 200 persons, the voters may decide to incorporate the jurisdiction. A "general law city", an incorporated community with fewer than 5,000 residents, may construct, own, and operate a water supply system. Cities having a population of more than 5,000 may accept the full powers of local government through the enactment of a "home rule" charter. The charter may direct, restrict, or prohibit the city from operating a facility to provide water service. If either a general law or a home rule city operate a water utility, it is termed a "municipal water system." Such a system is owned and operated by the community, and is directly accountable to the citizens' elected representatives. A municipality may choose to assign to the same entity the administrative responsibility for the provision of the services, such as sewage disposal. Water rates are often set by the local legislative body.

The Texas Constitution established water districts as institutions to control, preserve, store, or distribute waters from storms, floods, rivers, and streams for purposes such as navigation, power, drainage, and domestic consumption. This broad constitutional mandate has resulted in the creation of hundreds of districts with varying functions. Water districts are special units of local governments which provide water-related services within recognizable geographic boundaries. The special-purpose districts have limited powers and are autonomous government entities,

independent of cities and counties. The size of the service area may vary from a few acres to several counties. Water districts may be created under general or special laws. Present Texas statutes permit the formation of eight types of general law districts by petition and local referendum. A water district may also be created by the Texas Legislature.

River authorities are autonomous regional governmental entities established by the state to manage water resources in major Texas river basins. Since most major Texas rivers flow wholly within Texas, the state has been able to unilaterally establish river authorities. The Texas Legislature has created twenty-four regional entities which may be classified as river authorities.

Private profit-making firms may also provide water service to community residents. Because these entities are privately owned and exist to produce a profit, they are legally distinct from other water supply institutions. A private profit-making water system can be organized as an indvidual proprietorship (single owner), a partnership (two or more owners), or a corporation. Private water systems are often organized in unincorporated regions where no local government is responsible for the water supply function. The private water supply system has power similar to other private firms and no powers of government.

A nonprofit water supply corporation is a quasi-public entity established under law to provide water service. This kind of water supply corporation is required by state law to operate on a nonprofit basis. A private water supply corporation may be formed by three or more Texas citizens who apply for a charter from the Texas Secretary of State. Nonprofit water supply corporations tend to serve unincorporated regions for many of the same reasons as private systems.

Organizational Adaptation

Existing water supply entities may seek to enter into cooperative service arrangements in order to benefit from reduced unit costs of water supply through economies-of-scale of operation. An expansion in the numbers of customers served by a single water supplier can reduce the unit water costs. A cooperative water supply arrangement can take two basic approaches. If each participating water system wishes to maintain an independent water identity, all can cooperate in acquiring and/or treating water. Another approach involves combining water systems to form a new entity. Water supply service contracts are an institutional arrangement whereby a number of participating water systems can jointly obtain or treat water via a central facility without forfeiting their independent organizational identities. There are two distinct types of agreements: a "basic service contract" and a "joint service contract." The basic service contract is a formal agreement for one or more parties to purchase a water service from another party. This type of agreement is appropriate when one water supply system wishes to purchase water from or sell water to another water system. A joint service contract establishes the participating jurisdictions as equal partners in the provision of water. All parties share the planning, contracting, financing, and operating costs; and decisions are typically made by a joint governing body composed of representatives from each participating jurisdiction. The joint service contract is appropriate when two or more water supply entities wish to develop a new water resource cooperatively.

Any of the five types of water supply institutions can enter into either a basic or a joint service contract. However, the contracting authority of localities may be limited by local charter or ordinance.

A group of cooperating water systems may agree to join together legally for the purpose of achieving compliance with drinking water standards. Such amalgamation involves a shift of policy control, fiscal responsibility, and operational authority. It usually implies a permanent loss of organizational identity for one or more of the participating systems. Annexation, consolidation, and merger are three means to adapt the structure of water supply institutions.

Annexation occurs when a water system extends its service boundaries to include a neighboring area. A municipal water system will ordinarily expand to new territory when the municipality extends its corporate limits through annexation. The state legislature has provided some water districts and river authorities with the power to annex land. Although private water suppliers may expand their service areas, they cannot annex territory in a legal sense.

Consolidation refers to the joining together of two or more similar water systems. The old systems lose their former identity in the formation of one new water system. Texas law provides consolidation procedures for water districts, private water systems, and nonprofit water supply corporations.

A merger occurs when one water supply system absorbs one or more other systems. The absorbing water supply system continues its corporate existence, but takes over all rights, liabilities, franchises, and properties of the absorbed systems. An absorbed system thereafter has no corporate existence. Both private profit-making and nonprofit supply corporations in Texas can participate in mergers.

Methods of Financing Cooperative Water Supply Development

Although a cooperative water service arrangement may provide a sufficient economic base to improve water supply facilities, the water system officials must still decide the manner in which the development will be financed. One approach is to finance water facility construction, repair, and improvement entirely out of revenues generated by general taxation, special assessments, and water system charges. Other systems may choose to finance water projects by incurring long-term debt. In Texas, water suppliers may borrow funds by the issuance of bonds, time warrants, and certificates of obligation. Political subdivisions of the state and private or public nonprofit corporations may also seek financial or technical assistance from a number of federal or state agencies, including the Texas Department of Water Resources, the Texas Department of Health, the U.S. Department of Housing and Urban Development, the Farmer's Home Administration, or the U.S. Economic Development Administration.

Building Support

The particular type of water supply arrangement that a community accepts will reflect technological, economic, and political considerations. Those involved in considering the options will want to examine strategies for building political support among community residents for the creation of new institutions. Both institutional forms and financing methods must be subject to political scrutiny. Successful project development requires the careful coordination of the administrative, financial, legal, and political aspects of any potential cooperative water supply arrangement.

CHAPTER I

OPTIONS FOR COPING WITH THE SAFE DRINKING WATER ACT

INTRODUCTION

This chapter explores the problems of moving from the passage of a law to its implementation. The focus is on the regulation of contaminant levels in drinking water as proposed in the Safe Drinking Water Act, P.L. 93-523 (the Act). A dichotomy exists between those who decide and those who carry out the Act. Those who decide include the U.S. Congress, which passed the law, the U.S. Environmental Protection Agency (EPA), which has promulgated standards, and the states, which in most cases will accept a primary role in implementing the Act. However, ultimate responsibility for improving drinking water rests upon local water utilities and their customers, who pay the bills.

There are four types of implementation problems:

1. The roles of different agencies and the rules they will follow are not yet certain.

2. The Act may impose harsh consequences on small water suppliers not in current compliance with its requirements.

3. The meaning of *safety* and the balance between benefits and costs complicate any effort to regulate contaminants in drinking water.

4. The Act does not address the fate of water suppliers too small to be subject to jurisdiction.

Cooperation, cooptation, and conversion are three parts of a strategy to administer the Act under existing conditions of uncertainty. The implementation process should provide the time, technical assistance, and on occasion the financial leverage to allow these forces to work.

STRATEGIES FOR IMPLEMENTATION

Through the Safe Drinking Water Act, the Congress has directed the EPA and the states to require water suppliers to limit the contaminants in drinking water in order to reduce health risks. This task of persuading people of their own best interest has a venerable and honorable history in the water works profession. It may be useful to review how two civil servants involved with water supply in earlier times approached implementation.

Vitruvius

In the halcyon era of Augustus Caesar, a bureaucrat named Vitruvius stunned the water works community by suggesting the elimination of lead pipes because "water. . . conducted through lead pipes. . .is found to be harmful for the reason that white lead is derived from it, and this is said to be hurtful to the human system" (1). Although the journals of the period are not available, we can speculate that some Etruscan engineers objected to Vitruvius' recommendation on three grounds. First, the aqueducts had been used "safely" for centuries and water was already extensively treated, prior to entering the distribution system, in settling basins at the terminus of each aqueduct (2). Second, Vitruvius did not show a cause and effect relationship between lead pipes and health. Rather, he extrapolated from epidemiological (community use of lead paint) and occupational health (lead fumes) experiences (3). Third, Vitruvius did not demonstrate that health benefits would exceed the costs of replacing lead with earthenware pipes.

Vitruvius' suggestions were never implemented. His failure might have reflected a lack of consensus among water supply professionals that there existed a problem, or that his solution would be best. Another reason for inaction could have been that the magistrates, rather than the Roman Senate, held the purse strings for public works (4). Imagine how the magistrates, who used their personal fortunes to build civil works, must have felt to be accused of endangering the health of Rome!

It is possible to draw certain apparent parallels between Vitruvius' times and our own. The EPA has promulgated regulations limiting water contaminants. Water utility managers are not yet fully convinced that the health risks of certain contaminants justify the substantial costs to treat water or develop new sources. The notion that drinking water may not be "safe enough" may be perceived by suppliers as an accusation. While federal or state governments may sing for safe water, they do not pay the piper. The incremental costs will be paid by the persons who consume the water, whether or not they perceive that their health is endangered.

---

*This chapter is a reprint of a chapter in Russell, Cliff, (editor), *Safe Drinking Water: Current and Future Problems,* Baltimore, MD: The Johns Hopkins University, 1978. Reprinted with publisher's permission.

Vic Ehlers

The story of Vic Ehlers, Texas' first State Sanitary Engineer, provides an alternate paradigm. When Ehlers began work in 1915, major epidemics of communicable diseases were commonplace. For example, from January 1915 to September 1917, 1,682 Texans died of typhoid fever. Less than thirty towns in Texas had sanitary sewage collection systems and only seven had facilities for even partial treatment of drinking water (5).

Vic Ehlers recognized that small Texas communities could not easily finance water treatment plants. He encouraged compliance through the persuasion of public officials and the mobilization of public opinion (6, 7, 8). He also fostered a sense of pride and developed a locus for peer group pressure among water treatment operators by organizing professional organizations, such as the Southwest Water Works Association in 1920. These groups in turn spread the gospel of safe water, along with technological information, even to isolated water and sewer districts. Despite the fact that Texas had no law permiting the state to supervise or regulate suppliers (9), drinking water quality improved measurably. By 1933, there were forty towns that could boast a perfect bacteriological record for twelve consecutive months (10). By the late 1930s, Texas had more sewage treatment plants than any other state in the union (11).

One key to Ehlers' success was that he understood the water supply industry. This industry is composed of a large number of independent providers operating under a variety of legal charters. For example, in Texas there are approximately 2,000 water supply systems, whose ranks include municipalities, special water districts, water supply corporations, and private providers, such as mobile home parks (12). The populations served by these systems range from more than a million to less than twenty-five persons.

One parallel between Vic Ehlers' times and our own is that voluntary cooperation of water suppliers is a necessary condition for regulation. Most water suppliers are public or nonprofit entities that neither pay income taxes nor receive federal or state financial largesse. Thus, they are unaffected by either income tax incentives or traditional grant-in-aid programs. A state could threaten to revoke a supplier's certification of water as "acceptable for human consumption." However, unless water users are convinced that their water is unsafe, they may continue to use and pay for the water. The problem of implementation is not changed much since Vic Ehlers' day—rarely have so few had to regulate so many with so little leverage.

Administrative Strategies

A comparison of Vitruvius and Vic Ehlers leads to alternate strategies for implementing the Act. Vitruvius, of the righteous ends, did not blanch at the implications for existing water providers. Vic Ehlers, of the reasonable means, was as concerned with building momentum for incremental improvements over time as with immediate results. Although the states are beginning to implement the Act, it is uncertain whether the EPA and the states will emulate Vitruvius or Vic Ehlers. The remainder of this paper considers some administrative problems that state or federal regulators could face. In developing recommendations, this paper will let the spirit of Vic Ehlers motivate its methods. The theme is how to resolve the uncertainties that may inhibit the achievement of safe drinking water.

There are four types of problems that complicate the administration of the Act—procedural ambiguities, unintended harsh consequences for suppliers, inherent enigmata of the regulatory process, and drinking water risks not addressed by the Act. Each of these complications will be considered in the following sections.

ROLES AND PROCEDURES

There are four role problems related to ambiguities in the Act. First, federal agency mandates appear to overlap. Second, the federal concept of primacy may conflict with state expectations. Third, the strength of consumer action to push water system compliance is uncertain. Finally, variance and exemption procedures have yet to be fully defined.

Federal Agency Mandates

The Safe Drinking Water Act clearly identifies the EPA as the lead federal agency to administer it. However, EPA interests overlap the mandates of the Food and Drug Administration (FDA) and the Farmers Home Administration (FmHA).

The FDA is responsible for assuring safe preparation and processing of foods and drugs. When water is used in processing, does the EPA or the FDA have the responsibility for enforcement of process water contaminant levels? This subject is quite complicated and a full treatment of the issues is beyond the scope of this paper. It is clear that all involved would benefit if these two agencies would establish a common basis for limiting contaminants in water used in drug or food processing.

The FmHA administers a grant and loan program to assist in the construction of rural water supply systems. The FmHA loan program is predicated upon the ability of the water supply system to repay the note over its normal term. The enforcement of the Act may require some rural systems to install costly treatment equipment and may jeopardize the ability of the system to repay the FmHA note. Who is responsibile if there is a conflict between meeting the requirements of the Act and maintaining the economic viability of rural water systems?

A good example of this unintended overlap of EPA and FmHA roles is the case of the Grassland Water Supply Corporation (13). Until the FmHA intervened, the seventy-five individuals in Grassland, Lynn County, Texas, drew their drinking water from private wells. The FmHA, following

federal policies to develop rural water systems, encouraged these families to join together to form the Grassland Water Supply Corporation. The FmHA provided a low interest loan to construct a community water system. Returns from the completed operation barely meet FmHA repayment terms. There are no salaried officials responsible for the system; all labor is provided on a "good neighbor" basis (14).

With the advent of the EPA drinking water standards for fluorides, Grassland finds itself in conflict with one set of federal policies after having closely followed another set. Funds are not available to build a plant to remove fluorides. Should they return to private wells and abandon a community water system so recently constructed? The seventy-five individuals of Grassland really want little to do with government at any level. Now, with a community water system in place, the FmHA, the EPA, the Texas Public Utilities Commission, and the Texas Department of Health have entered their lives. A Grassland spokesperson summarized their frustrations:

> "We come under a federal agency ourselves (the FmHA) and we think that the rules should come through the FmHA. . . . There has to be some form of reconsideration for these small systems. You (the interviewer) should not even be here. You don't have any business coming down here to this system duplicating the efforts of the FmHA. . . . This overlap is in direct violation of President Carter's program to streamline the government. Leave it all up to the FmHA since they are the ones we owe the money to" (15).

On Primacy

State health departments may find the procedures surrounding the granting of state primacy, in connection with administration of the Act, to be puzzling. Prior to 1974, the states alone were responsible for regulating public drinking water supplies within their jurisdictions. In 1974, Congress took away their monopoly through passage of the Act, but gave the states the option to reclaim control under EPA supervision through primacy. As an incentive, Congress authorized renewable federal grants to support up to 75 percent of a state's water system supervision program. However, the Act clearly authorizes such aid on a year by year basis (16). It will be interesting to see how EPA administers the Act in ambivalent states such as Pennsylvania, which has declined to seek primacy. Even in states with primacy, the fate of P.L. 93-523 administration in the absence of administrative grants is uncertain. What would keep an administrator from firing the staff that federal funds had supported? In the next round of Safe Drinking Water Act amendments, Congress may wish to clarify its intentions. If Congress intended to extend the scope and quality of state public water supply supervision, why did it not authorize long-term financing for state administration? If the goal is to wean states from federal aid, might not Congress be well advised to consider fiscal disincentives to termination of primacy?

On Consumer Action

One pathbreaking provision of the Act requires water systems to notify users and the news media of violations of EPA regulations (17) Once alerted, water consumers can pressure the supplier to comply with the Act. One problem is that some suppliers are still not familiar with the Act and the notification regulations. In 1977, a group of graduate students and faculty at the Lyndon B. Johnson School of Public Affairs at The University of Texas at Austin conducted a survey of sixty-three water suppliers in Texas whose water exceeds the MCLs for at least one contaminant.* Only one-third of the suppliers surveyed could report receipt of the Texas Health Department compilation of information about the Act.** Of those surveyed, less than half the municipal water systems and only one in six private suppliers reported receipt of these books. Only half of the respondents reported contact with the Texas Department of Health regarding water hygiene; only one in twenty reported that they had conversations with the EPA. States and the EPA should continue their efforts to instruct suppliers regarding notification responsibilities. Water consumer participation would be expedited if the state would distribute sample forms to be used by noncompliant systems in their required communications with users and news media.

Variance and Exemption Procedures

For Texas, where there are 573 suppliers with drinking water that exceeds at least one MCL (19, 20, 21), the variance exemption process could be complicated. For a state to grant a variance or an exemption, at least an opportunity for a public hearing is required. No hearings may be requested by the public. However, a "worst case" could arise if (a) each system would request a variance from an MCL issued by Texas; (b) each community would wish to be

*The survey was part of a study of the impact of the Safe Drinking Water Act on Texas, which was made under contract to the Texas Department of Health (18).

**Project Participants interviewed 63 of 573 water suppliers not in current compliance with the MCLs. It is difficult, if not impossible, to make sweeping generalizations from such a small survey of Texas systems. Water systems were selected on the basis of the size of population served, type of ownership, financial status, geographic location, raw water source, type and severity of contaminants. The communities were not selected to be a random or even a representative sample. Therefore, all results should be viewed as illustrative, and should be qualified by the phrase "for the water suppliers surveyed."

involved, via a hearing, in the decision process affecting both the variance *per se* and the compliance schedule; and (c) EPA would resolve that the compliance schedules did not meet with its expectations. Under such conditions, Texas could face as many as 1,700 separate hearings to administer variances and exemptions (22). Such hearings could be costly for a state. In Texas, the possibility exists that two Department of Health attorneys may have to attend a single hearing, one to act as a hearing examiner and fact finder, and one to represent the Office of Water Hygiene as a party (23).

An alternative to hearings for individual systems would be hearings by classes of systems–but how to define a class of systems? Water systems grouped as to geographical propinquity might not share identical contaminant problems. Classes grouped on a "severity of contaminant" basis might differ substantially in terms of alternate sources of water or the prospects for combination with nearby suppliers with similar problems. Neither of these schemes takes account of system size, even though size is a prime determinant of the ability of a system to finance improvements.

UNINTENDED CONSEQUENCES OF THE ACT

The sponsors of the Act intended it to be a reasonable vehicle to achieve safe drinking water. Opponents feared that it could have unintended fiscal consequences for rural systems (24). This section explores small system costs to meet the requirements of the Act.

Private Systems

Privately owned water systems such as trailer parks or cotton gins (25, 26) are as liable as other systems to the provisions of the Act. In theory, municipal water systems can spread cost liability among consumers via water rates and federal or state subsidies. Private water supply corporations can spread the burden of improved treatment among the corporation owners, who in many cases are the system users. Mobile home park or cotton gin owners, however, bear sole liability for costs. The owner may attempt to pass on a portion of these costs to those who use the facility, but consumers can refuse to pay by moving elsewhere (as could consumers in municipalities). Such costs put a private park owner at a disadvantage versus competitors. One owner put his dilemma succinctly: ". . .people would move from (the) park with increased rates. . . ."(27). Another states that ". . .this will put all independent people out of business" (28). Because the trailer parks are small,* even if a few families move in response to higher rents due to increased water costs, the business impact could be substantial. The Act's impact upon private systems will be aggravated by their relative ignorance of its contents. Of twenty-four private systems responding, only one in six indicated that they had received the Texas Health Department compilation of information on the Act (30).

*Of the twenty-four private systems responding to a University of Texas Project question regarding system population, seven (29.2 percent) had less than 99 residents and another 11 (45.8 percent) had populations between 100 and 400–and most were closer to the lower end of the scale (29).

TABLE 1-1: OPTIONS FOR REDUCING FLUORIDES AND NITRATES

Water Treatments
Nitrate Removal
Demineralization (Ion Exchange)
Selective Ion Exchange
Reverse Osmosis
Electrodialysis
Fluoride Removal
Demineralization (Ion Exchange)
Reverse Osmosis
Lime Softening
Tricalcium Phosphate Adsorption
Non-Treatment Alternatives
Switch to Surface Waters
Change Groundwater Sources
Blend Raw Waters
Purchase of Finished or Bottled Waters

Small Public Systems

Of about 550 community water systems with drinking water that exceeds at least one MCL, 191 supply fewer than 100 persons. Another 177 systems serve 100-500 persons (31). How can these systems reduce contaminants and what will it cost to do so?

The principal contaminant problems in Texas are fluorides and nitrates that exist naturally in groundwater. Numerous water treatment processes and nontreatment alternatives can reduce the level of these inorganics. Table 1-1 lists a few of these options (32). The choice between these or other options depends upon many factors, such as the availability of alternate water sources; the volume of system flow; and the contaminant form (anion or cation), concentration, chemical oxidation state (valence), and solubility.

Inorganics removal and water source development could be expensive. According to one recent engineering study (33), the total cost of bringing Texas suppliers into fluoride and nitrate compliance could exceed $73 million in capital investment and $15.5 million of annually recurring operating and maintenance costs. Several LBJ School graduate students developed a simple simulation to calculate the water rate impacts of reverse osmosis treatment for several hypothetical but not unrealistic Texas communities (34).

This analysis found that the expenses of fluoride or nitrate removal could result in doubling of water rates for a very small community.

How May Small Systems Respond?

Are small Texas suppliers willing to remove fluorides or nitrates from drinking water? The LBJ Project members, who interviewed water system personnel, found resistance to voluntary compliance. If system managers recognize that their water supply does exceed the MCLs, they do not always view the water as a health risk. Forty percent of the systems interviewed which had excess nitrates expressed the feeling that the current standards are too strict. Nearly two-thirds of the operators of systems with excess fluorides felt that the MCL is too low (35). Feelings about the safety of current water supplies often surfaced during the questionnaire interviews. Some managers would refer to elderly town residents who had consumed that water over a lifetime with no apparent detrimental health effects. One water system owner stated that "other things will kill you graveyard dead"—but not fluorides (36). Some were simply skeptical of the MCLs: "I don't know where these magic numbers come from. I've never heard of any blue babies" (37).

The federal attitude, according to Douglas Costle, EPA Administrator, is that Congress intended local users to bear the costs of compliance (38). This attitude is consistent with the notion that drinking water systems should be self-supporting entities. The LBJ School survey made a special effort to elicit community expectations regarding the appropriate roles of federal and state governments and the local suppliers. The most frequent response was stated bluntly by a Seagraves official, "If they're gonna make us do it, they ought to pay for it. . ." (39).

When asked about state or federal assistance, fifty-five of sixty-three system representatives interviewed (87 percent) felt that the federal government should financially aid local water suppliers. Forty-six systems (73 percent) felt that the state should share the financial burden. These attitudes were consistent for all types of suppliers—municipalities, water districts, and private water systems (40). A follow-up question asked which level of government should bear the financial burden of system compliance. The most frequent response (twenty-one responses or 33 percent) was "mainly federal." Seventy-one percent of system representatives interviewed (forty-five systems) indicated some expectation of federal responsibility. Those who did not favor federal involvement were the private water suppliers (41).

Constraints to Small System Improvement

Even if a supplier accepted (a) that fluorides or nitrates are a risk to health; (b) that the benefits of compliance exceed the incremental costs; and (c) that such improvements are a local responsibility, are small water utilities capable of improving their drinking water? Unless financing and appropriate personnel are available, small suppliers may be unable to deliver acceptable water. This section considers financial impediments to system construction and personnel problems for operation.

Even for a system willing to bear the financial burden, the first question prior to building capital improvements is, "Where will the money come from?" Sinking or operating funds may be insufficient to finance new water source development. What about grants or loans to assist construction?

There are numerous federal and state programs that exist to provide aid to communities for water supply improvements. These programs listed in Table 1-2 are concerned either with drinking water, community development, or water development (42). Although the following discussion will focus on Texas, it may be applicable to many other states.

Two agencies, the U.S. Environmental Protection Agency and the Texas Department of Health, regulate the safety of drinking water. These agencies also provide, upon request, limited technical assistance to communities not in compliance with the Act.

A second group of agencies is concerned with community development. At the federal level, the Economic Development Administration (EDA) and the Department of Housing and Urban Development (HUD) give grants and loans for infrastructural improvements. Although HUD and EDA funds could be used to finance water treatment or source development, safe drinking water is not a high priority with either of these agencies. In addition, most of their aid is targeted at communities larger than those Texas towns with fluoride or nitrate problems. In Texas, the regional Councils of Governments (COGs) try to foster regional development. The COGs provide neither grants nor loans, and are not experienced providers of technical assistance on problems of drinking water.

A third group of agencies view water system development as their business. As previously mentioned, the federal Farmer's Homes Administration (FmHA) provides grants and loans for construction of rural public water supplies. It is uncertain whether the FmHA will place a high priority on water treatment applications. The Texas Water Development Board (TWDB) purchases bonds of local government entities as a means of loaning funds. The TWDB is a possible source of funds, but their financial resources are limited by legal and historical constraints. By law, TWDB can provide loans but not grants to political subdivisions. Water Board funds are loaned to a jurisdiction only if it can convince the loan officer that it can repay them. In passing on an application, the Board is required to consider Texas constitutional limitations on the bonded indebtedness of municipalities (25 percent of assessed property values) and Board guidelines for loans to special water districts (no more than 10 percent of assessed property value). In the past, drinking water treatment may have been a lower priority for the Board than water acquisition, storage, transmission and distribution (43).

TABLE 1-2: SOURCES OF ASSISTANCE TO SMALL PUBLIC WATER SYSTEMS IN TEXAS

Agency	Program	Type of Aid	FY 1977 Aid ($ millions)		FY 1977 Aid for Drinking Water Quality ($ millions)	Clients
Farmer's Home Administration	Rural Water and Waste Disposal Systems	loans	$31.46	(Texas)	not available	political subdivisions, private or public non-profit corporations
		grants	$17.347	(Texas)	not available	
Economic Development Administration	Public Works Facilities	grants	$26.822	(Southwest)	not available	associations representing an EDA-designated area or EDC, such as: –political subdivisions –Indian tribes –private or public non-profit corporations
	Supplemental 304 Projects	grants & loans	$ 0.694	Texas allocations	not available	
Department of Housing and Urban Development	Community Development	grants	$21.073	(Texas)	not available	SMSA or non-SMSA local governments
Environmental Protection Agency	Safe Drinking Water Act	loans	$ 0.0	(U.S.)	$0.0	public water systems
Texas Water Development Board	Water Development	loans & research	$19.339	(Texas)	$0.067 in research	political subdivisions
Texas Department of Health	Surveillance & Technical Assistance	laboratory	$ 4.300 (est.) in services	(Texas)	$4.2 (est.) in services	licensed water systems

In short, small Texas public water suppliers may not be able to afford water treatment to remove inorganics, even if they are inclined to comply with the Act. If funds to build treatment works were to materialize, it is uncertain whether users could afford the water rate increases needed to retire bonds and pay for system operation and maintenance.

Assume for a moment that money problems can be ignored. Do these small public systems have the operator talent necessary to manage sophisticated treatment plants? The LBJ survey disclosed that many system operators work part time, without pay, and lack experience with even conventional treatment systems. Chlorination is the only treatment of 87.3 percent of the systems responding in the survey (44). Thirty-nine of sixty-three systems reported that they pay operators (45). Would part-time operators, certified only for chlorination, be sufficiently trained to operate and maintain sophisticated fluoride or nitrate removal plants?

On Small System Compliance

There is an expectation gap between the federal government and small public systems with respect to compliance. The local systems do not feel willing or able to finance by themselves the necessary improvements. The federal government stands on the tradition of water supply as a distinctly local public utility and has few fiscal inducements to encourage water system compliance.

If there is no basis to induce, does there exist a way to compel local compliance? Federal and state governments have remarkably little leverage over local water suppliers. As discussed in the previous section, there are few federal subsidies that can be held hostage to enforce community compliance with the Act. Investment tax credits are incentives only to the private owners of public water systems. The branding by a state of local water as "unfit for human consumption" may have little effect if consumers do not share federal definitions of their own safety. Going to court to force either compliance or system shutdown would be a difficult decision for state water hygiene officials, particularly if they sympathize with people who argue that they have used the water for generations without apparent ill effects. Compulsion is not an easy route to compliance.

An alternate strategy would be to work with affected communities over a reasonable time period to achieve compliance, in the manner of Vic Ehlers. Such an approach would recognize that there are alternate routes to deliver acceptable water to consumers—via treatment, water source development, point of use purification, or purchase of bottled water. It could be combined with appeals to professional pride and water consumer pressures to facilitate compliance.

In order to resolve technical uncertainties, the EPA and the state could advise system operators and consumers on questions concerning the validity of the standards, the range of technical options, and associated costs. The EPA has begun this process, through (a) development of nontechnical discussions of the relation between human health and inorganic contaminants in water and (b) its research program on removal of inorganic contaminants from water (46). The EPA and the states should cooperate with treatment equipment manufacturers and bottled water vendors to estimate the costs associated with treatment and nontreatment approaches. One emphasis of all these programs should be upon the problems of small water suppliers.

To resolve doubts regarding system financing, the EPA and the states could devise new fund sources to assist systems in investment or operator training required to implement the Act. The EPA should collaborate with Congress to develop amendments to the Safe Drinking Water Act to provide for federal grants or loans for public and private nonprofit suppliers who must make major capital improvements to a system in order to comply with the provisions of the Act. Such aid programs could be targeted toward small water suppliers who have no access to other federal financial assistance.

TWO ENIGMATA AND AN OMISSION

The two preceeding sections have discussed problems that arise because of the Act. This section focuses on issues that exist despite the Act. Two subsections discuss the questions, "are there risks to health?',", and, "are the benefits worth the costs?" A third subsection investigates water-related health problems that do not fall under the jurisdiction of any regulatory program.

Are There Risks to Health?

Lest we leave the reader with a bad impression of Vitruvius, let's give credit where credit is due. Vitruvius was the first to recognize the difference between safety and risk. This distinction was rediscovered by Snow in London in 1854, by the Treasury Department's 1914 drinking water standards committee, by the current generation of regulators, and will continue to be rediscovered as long as societies regulate impurities in drinking water. The distinction is that safety is an enigma and risk is a question.

Safety is an enigma because scientists cannot conclusively answer the question "Is water with contaminant X safe?" To answer, *"Yes,* the water is safe," requires knowledge of the behavior of chemicals and living things far beyond the level mankind is likely to possess. To answer, *"No,* the water is not safe," implies the design and implementation of a controlled experiment capable of demonstrating an unambiguous cause-and-effect relation between the contaminant in drinking water and ill health. Such experiments are rare.

Scientists can make declarative statements on risk, by alluding to different levels of association between a water contaminant and ill health. Vitruvius could reason from epidemiological and occupational health experience to the assertion that lead in water is a risk to health. Snow could reason from the coincidence of cholera and water supply in areas of London to a relation between the two. Likewise, our contemporaries observe statistical associations between

cancer events and chlorinated organics in drinking water, and conclude that a relation between the two exists (47).

To those in the water supply business, this distinction between safety and risk is a fundamental part of the professional consciousness. It is useful to stress to those outside the profession this distinction, because it underlies expert disagreements relating to removal of contaminant X from drinking water. The answer to the question, "To remove or not to remove?" does not spring from ultimate truth, but is rather a reflection of a dominant professional and public consensus on acceptable risks at some point in time. Vitruvius was right, but in his time he was a lone voice. As one of the LBJ graduate students put the issue:

> "Scientists may be able to measure risks to health, but the real question of safety is not the effect *per se*, but the value judgment to determine a socially acceptable level of risk. . . . Judging safety is a normative, political activity" (48).

An underlying dilemma for any drinking water regulation program is the need to build a professional and public consensus that will legitimate appropriate water improvements. The EPA has taken the first step—to declare contaminants. However, disputes still exist among professionals over the legitimacy of removing at least two contaminants, fluorides and chlor-organics, from drinking water. These disputes pose an implementation problem for the Act and deserve prompt attention.

Questions have been raised by knowledgeable water researchers and dentists regarding the labelling of fluorides as contaminants. Fluorides at a low level in water are effective in the reduction of the incidence of tooth decay. At increased concentrations, fluoride consumption produces tooth mottling. At much higher levels, fluorides have a tendency to corrugate tooth enamel. Fluoride intake in excess of 20 mg per day for twenty or more years has been observed to cause a crippling skeletal fluorosis (49). What are the health risks and health benefits of fluoride at differing levels of intake? Some persons question whether the risks, as opposed to aesthetic sensitivities, are sufficiently recognized in the regulations implementing the Act.

Another question is the degree of risk associated with chlorinated organic by-products from the use of chlorine as a disinfectant in drinking water treatment. Several studies have shown apparent associations between the levels of chlor-organics in drinking water and the number of carcinomas in the associated human populations (50). No cause and effect relation of particular cancers in humans have been demonstrated; indeed, we are ignorant of any potential effects of some of the chlor-organic species identified in drinking water.

Although apparent risks of fluorides and chlor-organics at some levels are sufficient to warrant reductions of these contaminants, the EPA and the states should continue their current research efforts to quantify the relation between dose and effects. However, an administrative strategy should establish a clear standard based upon the best available health data. In this perspective, some persons question whether recent proposals to establish different classes of MCL violators based upon population size alone are wise. These proposals, which have surfaced both for chlor-organics and fluorides, may involve the granting of essentially unlimited time periods for compliance to systems with water that exceeds MCLs if the system (a) serves fewer than a designated number of users, and (b) is contaminated below some upper boundary. One example would be the granting of an open-ended compliance schedule for suppliers with excess fluorides if the fluoride concentration in water is below 4.0 mg/l and if the system serves fewer than 1,000 persons. The advantage of this approach is that it reduces the number of noncompliant communities for enforcement purposes. The disadvantage is that it is not easy to explain the noncompliant systems. How can one justify removal of fluorides from a water supply serving 1,010 persons, while a neighboring town of 990 need not comply? What happens if fifteen persons move from one town to the other to escape increased water rates? What is the answer if a resident of the smaller town questions whether the water is safe? Rather than change the standard, why not adopt the principal that while the MCL is fixed, the tempo of compliance will reflect the circumstances of the technology and the water supplier.

Are the Benefits Worth the Costs?

When conventional benefit/cost analysis was in vogue analysts would approach the issue of choice between capital investments and human health by attempting to portray existence as a stream of discounted benefits. Since the advent of multiobjective analysis, the dominant procedure for trading off incommensurates is to array and choose among them, rather than hide the value judgment in a maze of methodology. At what point do potential health benefits outweigh the costs of compliance?

Under any set of standards, there would be disagreement whether the costs of compliance are balanced by reductions of health risks. Under the present maximum contaminant levels, some observers have questioned whether the costs of activated carbon treatment are balanced by the possible reductions in human cancers rates. Such a value question has no ultimate "scientific" answer; the solution at any point in time will reflect the consensus of professional and, ultimately, popular opinion.

As a society, our choice to reduce chlor-organics is reflected in passage of the Act and in the regulations (51). However, many professionals are still uncertain whether the decision was correct. The EPA should recognize the legitimacy of such skepticism in the administration of its regulations, and should further explore the relation between chlor-organics and cancer to provide a stronger base of information. All involved should view implementation as a conversion process; a long run change in the climate of professional opinion is just as important as a shift in the treatment practices of the moment.

An Omission from the Act

There is at least one health issue related to drinking water that is not covered by the Act. Public Law 93-523 requires that all piped water systems with at least fifteen service connections or twenty-five customers comply with federal drinking water standards (52). What about those water providers with no piped distribution systems, such as the *colonias* of the lower Rio Grande Valley in Texas?

The *colonias* are poor, rural unincorporated communities that exist in Cameron, Hidalgo, and Willacy Counties in Texas. These collections of dwelling units have no formal ties with the governments of cities or towns. Therefore, the primarily Mexican-American residents do not pay property taxes, nor do they receive the typical public works amenities of piped water, treated sewerage, or street maintenance.

In 1976, an LBJ School Project studied these *colonias.* The Project participants conducted a one percent, spatially stratified random sample of *colonia* households in sixty-five *colonias* in Cameron and Hidalgo Counties. The Project found that although forty-five of the sixty-five *colonias* had access to treated drinking water, an estimated 57 percent of all *colonia* households do not receive treated water. Of the households surveyed, 45 percent obtained water from a public water supply stream, 40 percent from wells, 6 percent from irrigation ditches, and 7.5 percent from other sources. Of the households surveyed, about one-half disposed of sewage by cesspool or septic tank and about one-half by outhouse. None of the *colonias* has access to a sewage treatment facility (53).

One consequence of the primitive water and waste disposal systems is that the rates of diseases which are spread by water-borne fecal contamination (viral hepatitis, typhoid, bacillary, and amoebic dysentery) are higher in the lower Rio Grande Valley than in almost any other part of the United States (54). These diseases could be eliminated, for all practical purposes, with the introduction of disinfected drinking water and sanitary sewage treatment. Should not these conditions be addressed by a national safe drinking water law?

FINAL COMMENTS

A lesson of the stories of Vitruvius and Vic Ehlers is that the influence of a sensitive and patient civil servant may exceed the power of an idea, such as national drinking water standards, whose time has come. Those administering the Act should recognize and work to resolve producer ambivalence about contaminant health risks. EPA and the states should listen when water suppliers question whether health benefits exceed the costs of compliance. An implementation strategy should appeal to the professional pride and peer group pressures within the water works community. It should further provide the time, technical assistance, and on occasion the financial leverage to allow these forces to work. The interest groups involved should move beyond rhetoric that appears to be as sensitive to each new trace contaminant discovered in water as our detection devices.

All involved should recognize that the process of regulation of contaminants in water did not begin, nor will it end, with the Safe Drinking Water Act. This is but another step to achieve the goals set by the first commission on federal drinking water standards in 1914, namely, to provide water that is "free from injurious effects . . . and . . . offensiveness"; that is obtained "without prohibitive expense;" and that can meet water examinations that are "as few as simple as consistent with the end in view" (55).

REFERENCES

(1) Vitruvius, Marcus Pollio
The Ten Books on Architecture, New York: Dover Publications (republished translation by Morris Hicky Morgan), 1960, Book VIII, chapter VI, no. 10.

(2) de Camp, L. Sprague
The Ancient Engineers, New York: Ballantine Books, 1963, p. 211.

(3) Vitruvius, M. P., *op. cit.,* book VIII, chapter VI, no. 10-11.

(4) de Camp, L. S., *op. cit.,* p. 212.

(5) Dabney, Henry L.
"TDSH's Role in Water Pollution Control: Past and Present," *Southwest Water Works Journal,* vol. 56, no. 4, p. 20.

(6) Ehlers, Vic, Jr.
Interview with Mary Jo Seeman in Austin, Texas, 1977.

(7) Billings, Clayton
Interview with Mary Jo Seeman in Glen Rock, New Jersey, 1977.

(8) Smallhorst, David
Interview with Mary Jo Seeman in Austin, Texas, 1977.

(9) LBJ School Safe Drinking Water Policy Research Project (1976-77)
Impact of the Safe Drinking Water Act on Texas, Austin, Texas: The Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin, 1978, p. 117.

(10) Texas State Department of Health
Bulletin of the Texas State Department of Health, Austin, Texas: Texas State Department of Health, 1934.

(11) Dabney, Henry L.
Interview with Wayne Campbell in Austin, Texas, 1977.

(12) Ellison, Steven
Interview with Lee Solsbery in Austin, Texas, 1977.

(13) LBJ 1978, *op. cit.,* p. 86.

(14) Lawson, Gene
Interview with Lee Solsbery in Grassland, Texas, 1977.

(15) *Ibid.*

(16) Public Law 93-523, *42 USC 300,* December 16, 1974, section 1443.

(17) *Federal Register,* vol. 40, no. 51, March 14, 1975, section 141.32.

(18) LBJ 1978, *op. cit.*

(19) *Ibid.,* p. 88.

(20) Texas Department of Health Resources
"List of Systems in Excess of the Fluoride Maximum Contaminant Level," Austin, Texas: Texas Department of Health Resources (mimeo), 1976a.

(21) Texas Department of Health Resources
"List of Systems in Excess of the Nitrate Maximum Contaminant Level," Austin, Texas: Texas Department of Health Resources (mimeo), 1976b.

(22) Jeffrey, Edgar
Telephone interview with David Eaton in Dallas, Texas, 1978.

(23) Nelson, Hal
Telephone interview with David Eaton in Austin, Texas, 1978.

(24) Congressional Quarterly, Inc.
1974-CQ Almanac, Washington, D.C.: Congressional Quarterly, Inc., 1974.

(25) Catchings, Ron
Telephone interview with David Eaton in Austin, Texas, 1978.

(26) Texas Department of Health Resources, 1976a, *op. cit.*

(27) Deer Park Mobile Home spokesperson
Interview with Lee Solsbery in Lubbock County, Texas, 1977.

(28) Big "Q" Mobile Home Estates spokesperson
Interview with Lee Solsbery in Lubbock County, Texas, 1977.

(29) LBJ 1978, *op. cit.*, p. 95.

(30) *Ibid.*

(31) LBJ School Safe Drinking Water Policy Research Project (1977-78)
Options for Community Response to the Safe Drinking Water Act, Austin, Texas: Lyndon B. Johnson School of Public Affairs, The University of Texas, 1979.

(32) Sorg, Thomas J.
"Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics," *J. Am. Water Works Assn.*, vol. 70, no. 2, 1978, pp. 105-112.

(33) Bernard Johnson, Inc.
Economic Impact of the Safe Drinking Water Act on Texas, Austin, Texas: The Texas Water Development Board, 1977, pp. 1-1 through 1-3.

(34) LBJ 1978, *op. cit.*, pp. 142-178.

(35) *Ibid.*, p. 90.

(36) Dog Ridge water system spokesperson
Interview with Laura R. Doll and Angela Agee Hatton in Dog Ridge, Texas, 1977.

(37) Vernon water system spokesperson
Interview with LBJ Project staff in Wilbarger County, Texas, 1977.

(38) Costle, Douglas
Congressional Record, July 12, 1977, p. 6858.

(39) Seagraves water system spokesperson
Interview with Lee Solsbery in Gaines County, Texas, 1977.

(40) LBJ 1978, *op. cit.*, p. 91.

(41) *Ibid.*, p. 92.

(42) LBJ 1979, *op. cit.*

(43) *Ibid.*

(44) LBJ 1978, *op. cit.*, p. 90.

(45) *Ibid.*, p. 95.

(46) Sorg, T. J., *op. cit.*

(47) *Federal Register*, vol. 43, no. 28, part II, February 9, 1978.

(48) Doll, Laura
Unpublished graduate course paper on risk assessment at the LBJ School of Public Affairs, 1977.

(49) Safe Drinking Water Committee
Drinking Water and Health, Washington, D.C.: National Academy of Sciences, 1977, pp. 377-380.

(50) *Federal Register* 1978, *op. cit.*

(51) *Congressional Quarterly*, *op. cit.*, p. 423.

(52) Public Law 93-523, *op. cit.*, Section 1401 (4).

(53) LBJ School Lower Rio Grande Valley Policy Research Project
Colonias in the Lower Rio Grande Valley of South Texas: A Summary Report, Austin, Texas: Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin, 1977, p. 7.

(54) *Ibid.*, p. 10.

(55) *Public Health Reports*, vol. 29, 1914, pp. 2959-2967.

CHAPTER II
SETTING NATIONAL DRINKING WATER STANDARDS

A Look at the National Academy of Science's Study on Drinking Water and Health

INTRODUCTION

The Safe Drinking Water Act of 1974 (P.L. 93-523) gave the federal government the power to regulate the quality of the drinking water in most public and private water systems in the U.S. Prior to 1974, the federal government regulated only drinking water used by interstate carriers. The Act authorized the Environmental Protection Agency (EPA) to establish and enforce national regulations to protect the public from harmful contaminants in drinking water. According to the Act, EPA will specify maximum levels for contaminants in drinking water and set requirements for laboratory testing, monitoring, recordkeeping, and reporting systems. Maximum contaminant levels in drinking water are to be set to prevent occurrence of any known or anticipated adverse health effects in humans and to allow for an adequate margin of safety upon ingestion of a substance in drinking water. The Act refers to both primary and secondary drinking water regulations, distinguished by the fact that primary regulations deal with protecting public health and secondary regulations concern the public welfare.

The Safe Drinking Water Act called for the establishment of national primary drinking water regulations through three stages of action. First, EPA was to issue national interim primary drinking water regulations. Second, the National Academy of Sciences (NAS) was to undertake a study and complete a report on the human health effects of exposure to contaminants in drinking water. Third, based upon the study by the NAS, EPA was to issue revised national primary drinking water regulations.

National Interim Primary Drinking Water Standards were promulgated by the EPA and became effective on June 24, 1977 (1). Since not enough new data existed at that time to justify significant changes, many maximum levels for contaminants set in the Interim Standards were in large part based upon the existing 1962 Public Health Service Drinking Water Standards (2).

The second step–a study by an NAS Committee on Safe Drinking Water (the NAS committee)–has also been completed. The NAS report, entitled *Drinking Water and Health,* was delivered to Congress on June 20, 1977 (3). The EPA will propose revised national primary drinking water regulations based upon recommendations made in the NAS committee's report.

This paper focuses on the major issues and findings presented in the NAS committee's report to Congress. The first section examines the controversial question of how to determine human risk associated with ingestion of contaminants in drinking water. A second section examines the different classes of substances found in drinking water: microbiological contaminants, inorganic solutes, organic solutes, solid particles in suspension, and radioactive substances. A summary of the NAS committee's findings on the characteristics of the problems associated with each class of drinking water constituent is presented.

DETERMINING RISK AND SAFETY FOR WATER CONTAMINANTS

To report upon the human health effects of exposure to drinking water contaminants, the NAS committee had to cope with ambiguous concepts, such as safety or risk, and uncertainties in the type, quality, and quantity of data. The following section explores how toxicological and epidemiological studies can be used to estimate risk for contaminants in drinking water. Table 2-1 presents a glossary of terms associated with these health effect issues.

Toxicity Studies

Researchers may investigate the possible risks to man of dissolved substances and particles in drinking water via two types of studies: epidemiological and toxicological studies. The use of either method presents both advantages and drawbacks.

One benefit of epidemiological studies, which deal with human subjects, is that the researcher observes results of a pollutant on human populations. However, the NAS committee points out that epidemiological studies "involve large numbers of people whose exposure to the pollutant in question is commonly uncertain and confounded by exposure to other pollutants" (4). In addition, because epidemiological studies involve human beings and cannot be controlled as tightly as a laboratory study on animals, they often provide less precise information on the human risk related to one pollutant alone. On balance, epidemiological studies are a valuable source of information. They can trace causes of diseases and either amplify or contradict data from laboratory studies.

Toxicological studies involve exposure of cells or animals to specific substances at certain concentrations. Such studies can suggest a relationship between individual pollu-

TABLE 2-1: GLOSSARY OF TERMS

TERM	DEFINITION
epidemiological study	a research study using human populations as subjects
toxicological study	a laboratory study using cells or animals as subjects
noncarcinogenic	used to describe an agent which does not cause cancer
carcinogenic	used to describe a cancer-causing agent
mutagenic	used to describe an agent causing damage to genes
teratogenic	used to describe an agent causing deformed offspring
acute toxicity	harmful health effect or poisoning caused from a single ingestion of a substance at a certain level
chronic toxicity	harmful health effect caused from continuous ingestion of a substance or long-term exposure to a substance
reversible health effect	health effect can be turned around or reversed; may be life-threatening, extremely dangerous, or cause minor harm
nonreversible health effect	health effect following an injury which may have been detectable and reversible at one time, but which has become self-propagating
	health effect where there is death to irreplaceable body cells or cumulative effects from continued exposure
irreversible health effect	health effect which cannot be stopped even after exposure to harmful source has ceased; often life-threatening

tants and health effects in the subject animal species. The results of such studies can suggest that risks are associated with human exposure to the substance.

One problem arising from use of experimental laboratory results is that there is no easy, straightforward and reliable means now available for taking experimental data and employing it in the calculation of risks to large human populations. Toxicological studies are done under standardized conditions and control factors such as diet, temperature, and type of cells or animals used. However, in the real world, human populations are not exposed to substances under such controlled conditions. The size of animals may also limit the extrapolation of animal data to human risk, since size sometimes affects the rate at which a substance is distributed throughout the body. Other human and animal differences that limit extrapolation are the relative rates of chemical absorption through the gastrointestinal tract, metabolism, excretion, and substance storage. The number of animals exposed, the homogeneity of the animals used (versus the heterogeneity of human populations) or the selectivity of test-animal populations (versus possible human subgroup sensitivity), and environmental differences can account for different relative risks.

The leap from animal results to human implications is especially treacherous with regard to human risk from long-term low-level exposure to a pollutant. The health effects of continued, low-level exposure to a substance are often more difficult to assess in laboratory experiments

than acute effects from large doses. Chronic harmful effects may occur with few, if any, early warning signs. When signs are observed, as with cancer-causing substances, it may be too late to reverse the harmful effects. In addition, chronic animal exposure data are not easily compared to risks for human populations. Teratogenic or mutagenic effects can be somewhat more easily established with animal experiments, but associating the effects with human risk involves many uncertainties. Mutagenic effects on offspring by definition only appear in later generations. Some research is now being done to develop testing procedures to quickly assess the mutagenic and carcinogenic effects of a substance. The NAS committee stresses the urgent need for a quick, primary screening method to identify chemical compounds that may be hazardous and therefore need careful long-term study.

The Meaning of Risk and Safety

The NAS committee concludes that, rather than trying to determine safe levels for contaminants, it is more appropriate to specify doses exhibiting no observed adverse effect and define levels of acceptable risk to chemical exposure(5)*. In many cases it is difficult or impossible to establish absolutely a safe level for contaminants in drinking water. For example, a molecule of a substance may transform one body cell and lead to a fatal disease. Also, what is the dividing line between the number of damaged cells which can exist and still not interfere with living a healthy life? A complication is that humans are exposed to low levels of many possible carcinogens through food and air as well as via drinking water. What are the cumulative or interacting effects of exposure to low levels of many possible carcinogens?

Some health effects may be observed to occur above a certain threshold dose. For other injuries, limitations in present analytical methods, the quality of data, or differences among persons may prevent the establishment of a threshold dose at this time. Furthermore, a threshold dose may in fact not even exist for some types of damage. The NAS committee explains that instead of assuming that no threshold level exists for certain harmful substances, it may be more useful to estimate the concentration above which no adverse effect has been observed.

The NAS committee did adopt a nonthreshold approach for estimating risk to man from contaminants shown to be carcinogenic in laboratory animals. The presumption for carcinogens is that there exists no dose below which a certain harmful response would not occur. In the NAS report, the risk of cancer is expressed as the probability that cancer would be produced by continued daily ingestion over a 70-year lifetime of one liter of water containing a standard quantity (1 mg/liter) of substance (6).

It is important to note that using such a nonthreshold risk estimate approach does not mean that a substance cannot be allowed in drinking water. In some cases, such as fluorides, small quantities are beneficial. Thus, the risk of a pollutant must be weighed in making a final determination regarding its appearance in drinking water. As the NAS report points out, a pollutant must be used in such a manner as to minimize risk and maximize benefit (7). Such is the case in the use of chlorination to disinfect water. Carcinogenic by-products such as chloroform may be formed during the chlorination of water for disinfection. However, the risk of hazardous infectious diseases resulting from not chlorinating could be very high. Before switching from chlorination, the benefits of reduced chlorinated hydrocarbons should be weighed against the risks of infectious diseases.

The NAS committee defined procedures that should be employed to determine long-term harm of substances to animals and how to associate data obtained from animal research to estimates of human risk. The principles developed for use with carcinogens, mutagens, teratogens and with noncarcinogenic and nonmutagenic substances are outlined in table 2-2(8).

ELEMENTS FOUND IN DRINKING WATER

Five classes of constituents that can be present in water supplies include microorganisms, solid particles in suspension, inorganic solutes, organic solutes, and radioactive substances. The following section summarizes the NAS report on the characteristics and major health effects associated with the ingestion of each class of substances.

Microbiological Contaminants

Microbiological contaminants in water include such agents as bacteria, viruses, pathogenic protozoa, fungi, and algae. Bacteria, viruses and pathogenic protozoa in drinking water can and do cause ill health. Fungi and algae do not appear to be major causes of waterborne disease, although they can produce unpleasant tastes and odors in water (9).

Waterborne diseases caused by microorganisms occur only through the contamination of water by wastes of individuals or animals infected with disease-causing microorganisms. Diseases caused by microorganisms include gastroenteritis, giardiasis, typhoid, infectious hepatitis,

---

*The NAS study assumes two liters/day to be the average amount of water consumed per person. This also was the amount used by the EPA in calculating the Interim Drinking Water Standards. Although a NAS committee literature review found that 1.63 was an appropriate estimate of the average amount of drinking water consumed per person per day, a volume of two liters/day was adopted as representing the intake of the majority of water consumers. Of course, daily drinking water consumption can be a function of such items as temperature, humidity, and physical activity. The NAS report recommended that consideration be given to establishing some standards on a regional or occupational basis to take into account possible extremes in water consumption.

TABLE 2-2: PRINCIPLES FOR ESTIMATING HUMAN RISK

CARCINOGENIC, MUTAGENIC AND TERATOGENIC SUBSTANCES	NONCARCINOGENIC AND NONMUTAGENIC SUBSTANCES
Effects in animals, properly qualified, are applicable to man.	The nature and reversibility of the toxic effect must be considered.
Methods do not now exist to establish a threshold for long-term effects of toxic agents.	If a threshold for toxic effects is likely, the acceptable dose should be below the threshold.
The exposure of experimental animals to toxic agents in high doses is a necessary and valid method of discovering possible carcinogenic hazards in man.	If a threshold cannot be shown, an acceptable dose must be related to data from animal experimentation. Consideration should be given to: –the seriousness of the toxic effects –the likelihood and ease of reversibility –the variability of the sensitivity of the exposed populations –the economic and health-related importance of the material
Material should be assessed in terms of human risk, rather than as safe or unsafe.	

poliomyelitis, amebic dysentery, amebic hepatitis, and other gastrointestinal disturbances.

The principal bacterial agents that have been shown to cause human intestinal disease associated with drinking water are: *Salmonella typhi,* typhoid fever; *Salmonella paratyphi-A,* paratyphoid fever; *Salmonella* (other species and a great number of serotypes), salmonellosis, enteric fever; *Shigella dysenteriae, S. flexneri,* and *S. sonnei,* bacillary dysentery; *Vibrio cholerae,* cholera; *Leptospira* sp., leptospirosis; *Yersinia enterocolitica,* gastroenteritis; *Francisella tularensis,* tularemia; *Escherichia coli* (specific enteropathogenic strains), gastroenteritis; and *Pseudomonas aeruginosa,* various infections(10). Several other organisms have been associated with gastroenteritis, such as those in other genera of the Enterobacteriaceae: *Edwardsiella, Proteus, Serratia,* and *Bacillus*(11).

The viruses linked to human disease that are most likely to be transmitted by drinking water are the enteric viruses(12). The major human enteric viruses are the enteroviruses, reoviruses, parvoviruses, and adenoviruses(13). Several diseases involving the central nervous system, (and more rarely the skin and heart) result from the better-characterized enteroviruses: polioviruses, coxcackieviruses, and echoviruses(14). Some reoviruses and parvoviruses have been implicated in nonbacterial gastroenteritides(15). The major and most frequently reported viral disease sometimes transmitted by water is hepatitis A (infectious hepatitis)(16). Particles that closely resemble those of the enteroviruses transmit hepatitis A(17). Viruses may also eventually be designated as known etiologic agents of gastroenteritis; however, questions still remain about their role in the disease process.

There are specific drinking water problems associated with protozoan parasites, such as *Entamoeba histolytica,* the cause of amebic dysentery and amebic hepatitis, and *Giardia lamblia,* a flagellate responsible for gastrointestinal disturbances(18). Although cases of meningoencephalitis have been reported as caused by free-living, facultatively parasitic amebae of the genera *Naegleria, Hartmanella,* and *Acanthamoeba,* most such cases have been related to swimming in fresh water ponds or swimming pools(19). However, *Naegleria fowleri* and *Acanthamoeba* sp. have been isolated from tapwater in association with cases of primary amebic meningoencephalitis(20).

In the U.S., the most important parasitic intestinal worms that are transmitted in drinking water are nematodes, or roundworms(21). They include *Ascaris lumbricoides,* the stomach worm; *Trichuris trichiura,* the whipworm; *Ancylostoma duodenale* and *Necator americanus,* the hookworms; and *Strongyloides stercoralis,* the threadworm(22). Additionally, there is one cestode, or flatworm, which can infect humans–*Hymenolepsis nana,* the dwarf tapeworm(23). All other major helminthic parasites of man require intermediate hosts for the development of larval stages infective to man, and thus the ingestion of drinking water is a minor factor in the spread of these other parasites in the U.S.(24). Other non-parasitic nematodes sometimes found in water do not present a threat to man, but may give an unpleasant taste to finished water; these nematodes belong to the genera *Cheilobus, Diplogaster, Trilobus, Aphelenchus, Rhabditis,* and others(25).

Conventional flocculation, filtration and chlorination treatment can disinfect water and prevent the spread of waterborne disease via drinking water.

Since 1971, there has been a noticeable increase in infectious waterborne diseases related to microorganisms in the U.S. This trend follows a sharp decrease and then a leveling off of infectious waterborne diseases in the 1950's and 1960's. Possible reasons for this pronounced increase may either be (a) improved reporting of infectious disease outbreaks, or (b) an overloading of water treatment plants with source water of increasingly lower quality(26). The cited causes of most outbreaks in waterborne disease from 1971-1974 were deficiencies in treatment and contamination of groundwater (65% of the outbreaks and 63% of the cases) and inadequate or interrupted chlorination (31% of the outbreaks and 44% of the cases)(27).

Solid Particles in Suspension

Particles which do not dissolve in water may be inorganic or organic. Such insoluble particles are derived from soils and rocks but may also result from human activities or natural processes. Suspended solids in drinking water can include clays, fibrous particles of asbestos minerals, and organic particles from decomposition of plant and animal debris in the soil.

Information is sparse on the health effects resulting from ingestion of water containing suspended solids. Although it does not appear that clay and natural organic particulates are in themselves dangerous when ingested, they may present a health hazard through their ability to absorb, transport, and release inorganic and organic toxicants, bacteria, and viruses. Such harmful materials, when absorbed and transported by insoluble particles, may be protected from removal by water treatment. Some asbestos fibers are known cancer-causing substances when they are inhaled over a long period of time; there is some concern that asbestos mineral fibers in water may also present a carcinogenic health hazard(28).

Inorganic Solutes

Inorganic solutes refer to trace metals or metallic elements dissolved in drinking water. Trace metals include: barium, cadmium, chromium, lead, mercury, silver, beryllium, cobalt, copper, magnesium, manganese, molybdenum, nickel, tin, vanadium, zinc, and sodium. Other inorganic substances in water are arsenic, selenium, fluoride, nitrate, and sulfate.

Inorganic solutes can result from physical processes, such as the action of wind or water on rocks or soil, or from bacterial decay of vegetation. Human activities, including mining and manufacturing, can discharge inorganics into water supplies. Corrosion of materials by water in water distribution or storage systems can also add trace metals to drinking water.

Adverse health effects are related to the total intake of inorganics from water, air, and food. A person may inhale inorganic substances in an occupational setting or an urban environment. Many trace metals are found in food; indeed, humans often obtain more trace metals from their food supply than from drinking water. Exposure to inorganics from these other sources complicates the process of setting maximum contaminant levels for inorganic substances in drinking water.

Some of the trace metals are essential human nutrients, such as chromium, cobalt, copper, magnesium, manganese, molybdenum, tin, and zinc. Others, including lead, mercury, and cadmium, are not believed to be essential human nutrients and can be dangerous. All trace metals are known to be hazardous or show harmful effects at some intake level (29). At levels found in U.S. drinking water, many of the trace metals do not present a health hazard. However, there are several inorganic contaminants that possibly or clearly are health hazards. These include lead, mercury, arsenic, fluorides, and nitrates.

Lead is one of the most hazardous of trace metals. Although most raw water supplies do not contain lead, high concentrations can occur in tap water from soft, low pH waters which dissolve lead from service connections, lead-lined household piping, or soldered joints in the distribution system. Long-term, low-level ingestion of lead can be dangerous because lead accumulates in bone and tissues (30). Lead is also absorbed from food and air, especially among urban residents. Children are particularly vulnerable to lead, since they absorb greater amounts of lead in their systems from food and water than do adults. Inner city urban children are a special risk group, since some may ingest particles of flaking, lead-based paints often present in older urban dwellings.

Mercury is also dangerous. Industrial contamination of drinking water and ingestion of fish from an area contaminated with mercury are two routes of intake.

Although arsenic occurs naturally in water across the U.S., it is generally found in low concentration. High doses of arsenic can poison, damage the gastrointestinal tract, or cause cardiac abnormalities. Some epidemiological evidence associates high concentrations of arsenic in drinking water with skin cancer.

Fluoride is another inorganic widely found in water supplies, although usually in low concentrations. Small amounts of fluoride, about 1 mg/liter, are considered to be beneficial in reducing the incidence of dental caries in children. Conversely, long-term ingestion of fluoride in excessive levels can cause dental fluorosis ranging from unaesthetic mottling of tooth enamel to severe surface corrogations. Mottling is surface discoloration which varies from paper white to dark brown and usually occurs only after the tooth has erupted. Although a mild case of mottling may detract from appearance, it does not affect the structure of the tooth. For this reason, some could argue that moderate levels of fluoride are more of a psychological problem than a danger to health. Thus, there is uncertainty whether dental mottling is an adverse health effect, calling for a primary drinking water regulation, or merely a cosmetic nuisance which should be handled through a secondary drinking water regulation. Surface corrugation, generally accompanied by mottling, occurs when higher doses of fluoride in drinking water are ingested during tooth formation and

TABLE 2-3: INORGANIC SOLUTES AND SUSCEPTIBLE POPULATION SUBGROUPS

SUBSTANCE	SUSCEPTIBLE SUBGROUP OF POPULATION
barium	children
cadmium	people deficient in zinc and calcium, especially lactose-intolerant persons
copper	people with Wilson's disease, a disorder of copper metabolism
lead	children, especially in inner-city, urban areas
nitrates	infants

calcification. After about the first eight years of a child's life, however, no further structural damage occurs.

At high fluoride intakes, such as 10-20 mg per day over long periods of time, skeletal fluorosis (increased bone density) can also occur (31). Ingestion of amounts over 20-40 mg of fluoride per day for many years can cause skeletal fluorosis (32). Skeletal fluorosis is regarded as beneficial by some rather than harmful to health (33).

According to the NAS report, data available at the present time do not indicate that fluoride is a carcinogen. However, some researchers contend that fluoride is a possible cancer-causing agent (34).

Large concentrations of nitrates in drinking water have been identified as the source of two health dangers: (a) induction of methemoglobinemia, an infant blood disorder, and (b) possible formation of nitrosamines which are identified as possible carcinogens (35). The NAS committee questions whether the current interim primary standard for nitrates provides an adequate margin of safety against harm, especially since infants appear to be in more danger because of their susceptibility to methemoglobinemia.

Some persons are particularly vulnerable to certain inorganic substances. Table 2-3 illustrates some of these substances and their effects on certain susceptible population groups. The NAS committee has recommended that the interim standards for lead and nitrate be reviewed to determine if the standards are stringent enough to prevent harmful effects from drinking water contaminants in susceptible population subgroups.

Organic Solutes

Organic contaminants include pesticides and a variety of organic compounds such as vinyl chloride, nicotine, chloroform, carbon tetrachloride, and benzene. Although organics are often measured in drinking water samples, only a fraction of the exact chemical species have even been identified. Of those identified organic compounds, there is a dearth of information on harm to humans. A major concern regarding organic compounds in drinking water is their possible carcinogenic effects. For example, chloroform can be formed when chlorine, added to water for disinfection, reacts with organics in raw water. Chloroform is suspected of having long-term carcinogenic effects and is found in higher concentrations in drinking water than many other organics. No one knows the impact of small amounts of hundreds of synthetic organics ingested via drinking water over a long time.

The NAS committee concluded that sufficient data for judging either the carcinogenicity or acceptable daily intake for organic compounds existed for only three-fourths of the organic pesticides and for less than one-fourth of the non-pesticide organic compounds (36). Vinyl chloride is the

only organic compound currently identified as an actual human carcinogen, according to the NAS report, while benzene and benzo(a)pyrene are classified as suspected human carcinogens (37).

Several tables in the NAS report examined current estimates of the health risks associated with organics found in drinking water (38). Table 2-4 lists organics for which positive data on carcinogenesis exist. Table 2-5 presents those compounds for which sufficient data exist to calculate acceptable daily intake levels (ADI's). Tables 2-6 and 2-7 outline the organic compounds for which toxicological information was either inadequate or unavailable.

TABLE 2-4
CATEGORIES OF KNOWN OR SUSPECTED ORGANIC CHEMICAL CARCINOGENS FOUND IN DRINKING WATER

Compound	Highest Observed Concentrations in Finished Water, μg/liter	Upper 95% Confidence Estimate of Lifetime Cancer Risk Per μg/liter[a]
Human carcinogen		
Vinyl chloride	10	4.7×10^{-7}
Suspected human carcinogens		
Benzene	10	I.D.
Benzo *(a)* pyrene	D.	I.D.
Animal carcinogens		
Dieldrin	8	2.6×10^{-4}
Kepone	N.D.	4.4×10^{-5}
Heptachlor	D.	4.2×10^{-5}
Chlordane	0.1	1.8×10^{-5}
DDT	D.	1.2×10^{-5}
Lindane (γ-BHC)	0.01	9.3×10^{-6}
β-BHC	D.	4.2×10^{-6}
PCB (Aroclor 1260)	3	3.1×10^{-6}
ETU	N.D	2.2×10^{-6}
Chloroform	366	1.7×10^{-6}
α-BHC	D.	1.5×10^{-6}
PCNB	N.D.	1.4×10^{-7}
Carbontetrachloride	5	1.1×10^{-7}
Trichloroethylene	0.5	1.1×10^{-7}
Diphenylhydrazine	1	I.D.
Aldrin	D	I.D.
Suspected animal carcinogens		
Bis (2-chloroethyl) ether	0.42	1.2×10^{-6}
Endrin	0.08	I.D.
Heptachlor epoxide	D.	I.D.

Source: Safe Drinking Water Committee, *Drinking Water and Health*, Washington, D.C.: National Academy of Sciences, 1977, p. 794.

[a]See text of *Drinking Water and Health* for details (Introduction and Chapter II).

I.D. = insufficient data to permit a statistical extrapolation of risk; N.D. = not detected; D = Detected but not quantified.

TABLE 2-5

ORGANIC PESTICIDES AND OTHER ORGANIC CONTAMINANTS IN DRINKING WATER, CONCENTRATION, TOXICITY, ADI, AND SUGGESTED NO-ADVERSE-EFFECT LEVELS.

Compound	Maximum Observed Concentrations in H_2O, µg/liter	Maximum Dose producing No Observed Adverse Effect, mg/kg/day	Uncertainty Factor[a]	ADI[b] mg/kg/day	Suggested No-Adverse-Effect Level from H_2O, µg/liter Assumption[c]	
					1	2
2,4-D	0.04	12.5	1,000	0.0125	87.5	4.4
2,4,5-T		10.0	100	0.1	700	35.0
TCDD		10^{-5}	100	10^{-7}	7×10^{-4}	3.5×10^{-5}
2,4,5-TP	detected[d]	0.75	1,000	0.00075	5.25	0.26
MCPA		1.25	1,000	0.00125	8.75	0.44
Amiben		250	1,000	0.25	1,750.0	87.5
Dicamba		1.25	1,000	0.00125	8.75	0.44
Alachlor	2.9	100	1,000	0.1	700.0	35.0
Butachlor	0.06	10	1,000	0.01	70.0	3.5
Propachlor		100	1,000	0.1	700.0	35.0
Propanil		20	1,000	0.02	140.0	7.0
Aldicarb		0.1	100	0.001	7	0.35
Bromacil		12.5	1,000	0.0125	87.5	4.4
Paraquat		8.5	1,000	0.0085	59.5	2.98
Trifluralin (also for Nitralin and Benefin)	detected	10	100	0.1	700.0	35.0
Methoxychlor		10	100	0.1	700.0	35.0
Toxaphene		1.25	1,000	0.00125	8.75	0.44
Azinphosmethyl		0.125	10	0.0125	87.5	4.4
Diazinon		0.02	10	0.002	14.0	0.7
Phorate (also for Disulfoton)		0.01	100	0.0001	0.7	0.035
Carbaryl		8.2	100	0.082	574	28.7
Ziram (and Ferbam)		12.5	1,000	0.0125	87.5	4.4
Captan		50	1,000	0.05	350	17.5
Folpet		160	1,000	0.16	1,120	56.0
HCB	6.0	1	1,000	0.001	7	0.35
PDB	1.0	13.4	1,000	0.0134	93.8	4.7
Parathion (and Methyl parathion)		0.043	10	0.0043	30	1.5
Malathion		0.2	10	0.02	140	7.0
Maneb (and Zineb)		5.0	1,000	0.005	35	1.75
Thiram		5.0	1,000	0.005	35	1.75
Atrazine	5.1	21.5	1,000	0.0215	150	7.5
Propazine	detected	46.4	1,000	0.0464	325	16.0
Simazine	detected	215.0	1,000	0.215	1,505	75.25
Di-n-butyl phthalate	5.0	110	1,000	0.11	770	38.5
Di (2-ethyl hexyl)	30.0	60	100	0.6	4,200	210.0
Hexachlorophene	0.01	1	1,000	0.001	7	0.35
Methyl methacrylate	1.0	100	1,000	0.1	800	35.0
Pentachlorophenol	1 4	3	1,000	0.003	21	1.05
Styrene	1.0	133	1,000	0.133	931	46.5

Source: Safe Drinking Water Committee, *Drinking Water and Health.* Washington, D.C.: National Academy of Sciences, 1977, pp. 796-797.

[a]Uncertainty factor—the factor of 10 was used where good chronic human exposure data was available and supported by chronic oral toxicity data in other species, the factor of 100 was used where good chronic oral toxicity data were available in some animal species, and the factor 1,000 was used with limited chronic toxicity data.

[b]Acceptable Daily Intake (ADI)—Maximum dose producing no observed adverse effect divided by the uncertainty factor.

[c]Assumptions: Average weight of human adult = 70 kg. Average daily intake of water for man = 2 liters.

1. 20% of total ADI assignment to water; 80% from other sources.
2. 1% of total ADI assigned to water; 99% from other sources.

[d]Detected but not quantified.

TABLE 2-6

ORGANIC PESTICIDES AND OTHER ORGANIC CONTAMINANTS FOUND IN DRINKING WATER*

Compound	Highest Concentration in Finished Water, μg/liter
Acetaldehyde	0.1
Acrolein[a]	
Bromobenzene	detected[b]
Bromoform	detected
Carbon disulfide	detected
Chloral	5.0
Chlorobenzene	5.6
Cyanogen chloride	0.1
1,2-Dichloroethane	21.0
2,4-Dichlorophenol	36.0
2,4-Dimethylphenol	detected
e-Caprolactam	detected
Hexachloroethane	4.4
o-Methoxyphenol	detected
Methyl chloride	detected
Methylene chloride	7.0
Phenylacetic acid	4.0
Phthalic anhydride	detected
Propylbenzene	< 5.0
t-Butyl alcohol	0.01
Tetrachloroethane	4.0
Tetrachloroethylene	<5.0
Toluene	11.0
Trichlorobenzene	1.0
1,1,2-Trichloroethane	detected
Nicotine	3.0
Methomyl[a]	
Cyanazine	detected
Xylene	<5.0

Source: Safe Drinking Water Committee, *Drinking Water and Health*, Washington, D.C.: National Academy of Sciences, 1977, p. 798.

[a]Not detected in finished water.

[b]Detected = detected but not quantified.

*Although these contaminants were present in measurable concentrations in water, the Academy concluded that insufficient data on chronic toxicity existed to calculate on acceptable daily intake (ADI) estimate.

TABLE 2-7

ORGANIC CONTAMINANTS FOUND IN DRINKING WATER WITH NO AVAILABLE INFORMATION ON CHRONIC TOXICITY

Compound	Highest Concentration in Finished Water, μg/liter	Highest Concentration in Raw Water, μg/liter
1,2-*Bis*(chloroethoxy) ethane	0.03	
Bis(2-chloroisopropyl) ether	1.58	
Bromochlorobenzenes	detected	
Bromodichloromethane	116	11
Butyl bromide	detected	
Chloroethyl methyl ether	detected	
Chlorodibromomethane	100	1.4
Chlorohydroxybenzophenone	detected	
Chloromethyl ethyl ether	detected	
Chloropropene	detected	
Crotonaldehyde	5.0	
Dibromobenzene	detected	
Dibromodichloroethane	0.63	
1,3-Dichlorobenzene	<3.0	
Dichlorodifluoroethane	detected	
Dichloroiodomethane	0.5	
1,1-Dichloro-2-hexano	1.0	
1,2-Dichloropropane	<1.0	
1,3-Dichloropropene	<1.0	
1,2-Dimethoxybenzene	detected	
4,6-Dinitro-2-aminophenol	detected	
Dioctyladipate	20.0	
Hexachloro-1,3-butadiene	0.07	
Isodecane	5.0	
Metachloronitrobenzene	detected	
Methylstearate	detected	
Nonane	4.0	
Octyl chloride	detected	
Pentachlorophenyl methyl ether	0.1	
1,1,3,3-Tetrachloroacetone	1.0	1.0
2,4,6-Trichlorophenol	detected	
Trimethylbenzene	6.1	

Source: Safe Drinking Water Committee, *Drinking Water and Health,* Washington, D.C.: National Academy of Sciences, 1977, p. 799.

Radioactivity

Radiation can occur from naturally occurring radioactive elements, from man-made X-rays, and from cosmic rays which bombard the earth from space (39). Radiation in drinking water exists in the form of radionuclides. Minute traces of radioactivity are common in all drinking water, although the type and concentration vary. Questions concerning health effects of radiation in water revolve around the consequences of ingestion of various types of radiation in drinking water in small doses over a long time. Radiation can produce three types of adverse health effects–damages to genes (mutagenesis), to cells (cancer), or to offspring (teratogenesis).

According to the NAS report, radiation found in drinking water is a very small proportion of the total amount of radiation to which humans are exposed. Thus, it is difficult to measure the effects of radiation from drinking water ingestion alone. The NAS committee does conclude, however, that certain concentrations of radium are associated with a higher risk of bone cancer (40).

CONCLUSION

Ensuring a healthy drinking water supply for the country is a formidable task. As the NAS study committee's report *Drinking Water and Health* illustrates, not only are there hundreds of substances present in our drinking water supplies but the health effects of these contaminants are often unknown. Thus, predicting risk levels for drinking water contaminants is difficult. In many cases an absolutely safe thrsehold dose for a substance may not even exist. Complicating factors are a heterogeneous human population whose members' susceptibility to harm from drinking water contaminants varies; differences among individuals in the quantities of water (and hence amount of contaminants) consumed; and opportunities other than drinking water for exposure to contaminants, such as through food and air. The EPA will clearly have to consider these factors when promulgating and revising primary drinking water standards, both now and in future years.

REFERENCES

(1) U.S. Environmental Protection Agency
"Water Programs, National Interim Primary Drinking Water Regulations," *Federal Register,* Vol. *40,* No. 248, December 24, 1975, Part IV.

(2) Public Health Service
Public Health Service Drinking Water Standards, Washington, D.C.: U.S. Department of Health, Education and Welfare, 1962.

(3) Safe Drinking Water Committee
Drinking Water and Health. Washington, D.C.: National Academy of Sciences, 1977.

(4) *Ibid.*, p. 19.

(5) *Ibid.*, p. 24.

(6) *Ibid.*, p. 490.

(7) *Ibid.*, p. 21.

(8) *Ibid.*, pp. 53-57.

(9) *Ibid.*, p. 63.

(10) *Ibid.*, pp. 66-67.

(11) *Ibid.*, p. 67.

(12) *Ibid.*, p. 88.

(13) *Ibid.*, p. 88.

(14) *Ibid.*, p. 101.

(15) *Ibid.*, p. 101.

(16) *Ibid.*, p. 90.

(17) *Ibid.*, p. 88.

(18) *Ibid.*, p. 112.

(19) *Ibid.*, p. 113.

(20) *Ibid.*, p. 113.

(21) *Ibid.*, p. 115.

(22) *Ibid.*, p. 115.

(23) *Ibid.*, p. 115.

(24) *Ibid.*, p. 115.

(25) *Ibid.*, p. 116.

(26) *Ibid.*

(27) *Ibid.*, p. 65.

(28) *Ibid.*, p. 135.

(29) *Ibid.*, pp. 303-304.

(30) *Ibid.*, p. 309.

(31) The Safe Drinking Water Policy Research Project
Impact of the Federal Safe Drinking Water Act on Texas, Austin, Texas: The University of Texas at Austin, Lyndon B. Johnson School of Public Affairs, April, 1978, p. 36.

(32) Safe Drinking Water Committee, *op. cit.*, p. 434.

(33) *Ibid.*

(34) *Ibid.*, pp. 381-389.

(35) *Ibid.*, p. 437.

(36) *Ibid.*, p. 790.

(37) *Ibid.*, p. 794.

(38) *Ibid.*, pp. 794, 796-797, 798, 799.

(39) ReVelle, Charles, and Penelope ReVelle
Sourcebook on the Environment. Boston, Mass.: Houghton Mifflin Co., 1974, p. 263.

(40) Safe Drinking Water Committee, *op. cit.*, p. 898.

CHAPTER III

COMMUNICATION AND THE SAFE DRINKING WATER ACT

The purpose of this paper is to consider how to disseminate information in Texas regarding the Safe Drinking Water Act (the Act). The first section describes methods which can be used by communicators. The second section examines several coordinated information campaigns. The third section develops recommendations for a public information effort in Texas to insure that all water systems not presently in compliance with the Act are notified of their status and assisted in meeting federal public information requirements.

The problems with communication of information regarding the Act are how to (a) transmit a large amount of information to water system operators, and (b) see that these officials in turn inform their customers of those portions of the information pertinent to them.

Both state and local authorities have notification responsibilities under the Act. As part of its primacy duties, Texas needs to comply with the communications provisions of the Act. In recognition of this problem, any financial grant from the Environmental Protection Agency (EPA) to support state administrative efforts requires that ten percent of the total budget must be used for enslisting public participation (1). Local water suppliers must notify consumers and news media in the event of non-compliance or face stiff penalties.

For consumers, the rationale of notification requirements is that allowance be made for citizen participation. The Act places the final burden upon the water consumer. Individual consumers and groups representing them can (a) participate in the development of regulations under the Act; (b) petition for public hearings provided by regulation; (c) ensure that local utilities are adequately financed; (d) petition the Administrator and state authorities to carry out the emergency provisions of the Act; and (e) bring civil suits against the utility, the Administrator, or state authorities if it is believed that they have failed to properly implement the Act (2). As one author has stated, "The consumers are more than an address label on the water bill; their role has been greatly expanded. They are expected to be the ultimate watchdogs of the entire system" (3).

Although public notification may place a burden on local water suppliers, making consumers aware of the complexities of producing safe water is aimed at benefiting water systems over the long run. Customers may be less inclined to take their water systems for granted and more willing to finance needed improvements when adequately informed of the problems involved (4).

A study at the LBJ School of Public Affairs in 1977 found that information regarding the Act has yet to be effectively communicated to local water suppliers. This study asked representatives of 63 small water systems whether they were familiar with the Act. Nearly all (96.8%) of the operators questioned reported no contact with the federal government concerning the Act and more than half (50.8%) did not recall contact with state agencies regarding the Act. Moreover, the Texas Department of Health's basic educational tool, the "Bluebook," had not been received by 63.5 percent of the operators questioned (5). Although the survey was limited in scope, it is reasonable to infer that much remains to be done to disseminate information on the implications of the Act in Texas. It also follows that water consumers can have little knowledge of the Act when suppliers are inadequately informed. Since lack of information could become a constraint to effective Act implementation, it may be useful to review how information can be disseminated.

METHODS OF INFORMATION DISSEMINATION

Of the more than 2,000 existing suppliers in the state, the Texas Department of Health (TDH) has identified 573 water systems that exceed at least one maximum contaminant level (MCL). One task of primacy is to inform each of the systems of the requirements of the Act and how it will affect them. The TDH has begun to notify these noncompliant systems of their status and the steps they may need to take to correct their problems.

In planning such a communications effort, it is helpful to study the methods which can be utilized. Among experts in the communications field, there is controversy about which communication mode is most effective. For example, written data usually provide more information than oral because receivers can set their own pace while reading but are forced to go at the rate of the speaker while listening. However, it is more difficult for receivers to ignore an oral message, where the speaker is in face-to-face contact with the listeners (6). The type and size of the audience also influence the type of information that can be transmitted. To reach a large population, the information must be more general than that intended for a select audience (7). For example, if a description of the Act is to be distributed to

the general public, communication would probably be through mass mailings. Direct contact through oral presentation might be more effective for technical information. Communications studies have shown that there are few significant learning differences between spoken or written messages, but that there is a significant difference in attitude change in face-to-face communication. Face-to-face communication has been found to be more effective than any other form (8). A communicator should be concerned with both influencing attitudes and encouraging direct action. For drinking water, a communicator must first educate the listener to the notion that their drinking water may not be as safe as it could be. The communicator must then describe how to improve present water supplies.

How much time, money, and resources should be allocated to such communication? TDH and other agencies have spent several years trying to publicize the Act. Why is it that so many utilities, and the public in general, claim not to have heard of the Act?

Certainly a wide variety of strategies have been adopted by different groups. Table 3-1 lists several modes of information dissemination. These methods have been used by federal, state, and local agencies to publicize the Act in Texas. Each method focuses on a particular audience type and size.

How effective are these strategies? It is hard to say, because few communicators collect data on message effectiveness. The concept of feedback–ascertaining the effectiveness of the message being delivered via direct questioning of the audience–is a way to evaluate communication. It is not easy to insure two-way communication. For example, the Texas League of Women Voters inserted a feedback questionnaire with film packets they distributed. Of the more than 500 questionnaires distributed fewer than twelve were sent back (9). The consensus among the communicators interviewed for this report was that the amount of feedback will remain low unless interviewers are able to go into the field to personally question audience members.

Some of the major modes of communication are through key administrators, broad issue mailings, mass media, and public meetings. These approaches are discussed in the following sections.

Key Administrators

One way to communicate personally while simultaneously reaching a large audience is to utilize a "key administrator". This person can pass information on to other individuals in a group, organization, town, or constituency (10). The Texas Municipal League, which is a professional association of 785 member cities (including 98 percent of Texas towns with a population of 1,000 or more), uses this approach (11). The key official, often a city mayor, councilperson, or secretary, is identified and his or her name is placed on a mailing list. When events warrant, the League's public information office translates a law or regulation into a nontechnical memorandum. This memo is attached to a copy of the law and mailed to the key official, who can then explain it to the community (12).

The Lower Rio Grande Valley Development Council uses key administrators in a less formal way. The Council needs to reach a smaller population (about 411,000), and can distribute information on a more personal level. The

TABLE 3-1
METHODS OF INFORMATION DISSEMINATION FOR LARGE AUDIENCES

Method	Type	Type of Audience	Employed By
Key Administrator	face-to-face	non-technical	TML, LRGVDC
Broad-Issue Mailings	printed	non-technical	TLWV, TDWR, TDH, EPA
Mass Media	radio, television, film	non-technical	TLWV, TDWR, LRGVDC, EPA
Public Meetings	face-to-face	technical or non-technical	A&M, LRGVDC

Code:

TML: Texas Municipal League
TLWV: Texas League of Women Voters
TDWR: Texas Department of Water Resources
TDH: Texas Department of Health
EPA: Environmental Protection Agency
LRGVDC: Lower Rio Grande Valley Development Council
A&M: Texas A&M Engineering Extension Service

Council utilizes between fifty and 100 key officials, usually spokespersons of neighborhood and civic organizations. Often these spokespersons are on a first-name basis with the people they represent (13).

Broad-Issue Mailings

Information aimed at a large audience should use general, nontechnical language and seek to avoid going over the heads of the readers. Most mass mailings regarding the Safe Drinking Water Act have of necessity been aimed at non-expert readers.

An example is the "Project Safewater" packet put together by the Texas League of Women Voters (the League). EPA granted the League $9,000 to be used to educate Texas citizens about the Safe Drinking Water Act (14). A twelve-member task force prepared a high-quality program in nontechnical language. They produced 1,500 "Project Safewater" packets, 4,000 brochures, and sent press releases to all major Texas newspapers. Letters describing the Act were sent to Texas legislators, state and regional agencies, councils of government, major restaurants, hotels, motels, colleges, county agents, farmers' and ranchers' organizations, and civic clubs, among others (15).

The packet itself is appealing and well-designed, consisting of several EPA and League pamphlets, as well as six two-paged letters and a small poster. An order blank for free additional copies of the material is also included. The project director has expressed satisfaction with the packet. She believes that it was effective and reported positive evaluations from the audience for which it was intended (16).

The Texas Department of Water Resources also distributes material geared to the general public. Their first and second "Readers on Water Quality," each of which contains less than twenty pages, are simple, basic descriptions of water treatment problems (17). "Twenty Questions About Water Quality" is a one-page list of questions designed to give the reader an elementary grasp of the Texas water situation (18).

The EPA publishes many educational pamphlets regarding the Act. These range from nontechnical descriptions to detailed scientific regulations of the Act.

The Texas Department of Health distributed a technical handbook describing the Act and its implications, entitled *The Safe Drinking Water Act* and commonly known as the *Bluebook*. This guidebook for water system operators describes the Act and its jurisdiction, enforcement, maximum contaminant levels, and monitoring and reporting requirements. The *Bluebook* is the major source of information for Texas water suppliers. It has been distributed at the "short schools" held by the Texas A&M Engineering Extension Service, at regional sections of the American Water-Works Association, and to anyone who requests a copy (19).

Table 3-2 lists some of the publications of the agencies.

TABLE 3-2
INFORMATION PUBLICATIONS:
THE SAFE DRINKING WATER ACT

Title	Agency	Format
"A Drop to Drink"	EPA	Pamphlet
"Highlights of the SDWA of 1974"	EPA	Pamphlet
"Is Your Drinking Water Safe?"	EPA	Pamphlet
"Handbook on Public Notification"	EPA	Booklet
"The SDWA" (Bluebook)	TDH	Booklet
"1st Reader on Water Quality"	TDWR	Pamphlet
"2nd Reader on Water Quality"	TDWR	Pamphlet
"20 Questions about Water Quality"	TDWR	Letter
"Water Quality Management in Texas"	TDWR	Pamphlet
"You Are What You Drink"	TLWV	Letter
"Some Provisions of the SDWA"	TLWV	Letter
"The SDWA: What Will it Cost?"	TLWV	Letter
"Legislation for the SDWA"	TLWV	Letter
"Enforcement of the SDWA"	TLWV	Letter
"How to Get into the (SDW) Act"	TLWV	Letter

Code:

EPA: Environmental Protection Agency
TDH: Texas Department of Health
TDWR: Texas Department of Water Resources
TLWV: Texas League of Women Voters

Mass Media

Television is an effective but expensive form of communication which has been used only by the larger agencies. It is an effective tool because it arouses attention and reaches a large audience. But, because television is voluntarily received, the viewer can easily disregard a message. If a person attends to a television message, however, studies have shown that there is a high probability that he or she will be affected by it. Although costly, the impact of a thirty- or sixty-minute documentary "special" can be substantial.

The Texas Department of Water Resources uses newspapers to disseminate information because they are comparatively inexpensive and are successful in informing

people of issues. Public relations "blurbs", editorials, and informative articles are the forms most commonly utilized (20).

Slide shows or films are an alternative form of mass communication for groups with limited funds. For example, the Lower Rio Grande Valley Development Council uses slide shows in general meetings. The Texas League of Women Voters composed a self-explanatory slide show for their "Project Safewater" campaign.

The League's slide show, entitled "The Water We Drink," is twenty-two minutes long with narration on cassette and is aimed at a general audience. It includes an interview on water standards with Henry Graeser, a Texas member of EPA's National Drinking Water Advisory Council. Mr. C.K. Foster, Chief of the Water Hygiene Division of the Texas Department of Health is interviewed about compliance with the Act. The thrust of the production, however, is to provide interviews with "people on the street"—to explore their attitudes toward drinking water and their views about the Act. The slide show has been used extensively by schools and civic organizations in the Austin and San Antonio areas. The project director has expressed dissatisfaction with it, feeling it is too long and too technical. In addition, she feels it lacked the important factor of a "big name" to draw attention to it (21).

Public Meetings

Meetings can be a powerful way to communicate, since they involve face-to-face interaction, allow for feedback via "question and answer" sessions, and can utilize visual aids. Agencies dealing with the Safe Drinking Water Act have used meetings extensively to inform the public about the Act and its consequences. Public meetings, whether they are called conferences, seminars, or open hearings, have been found to be the most cost-effective form of communication, provided prior advertising is done to insure a large audience (22).

A useful and effective example of meetings as a mode of communication is the "short school" courses organized by the Engineering Extension Service of the Texas A&M University System. There are sixteen off-campus and twenty-six campus-contained classes dealing with water supply problems per year. All public and private employees of water utilities must be licensed by TDH, and their training is done via these short courses. Operator certifications must be renewed; this is also done through the Extension Service. TDH administers proficiency tests following completion of each session.

The Extension plans the courses to be as effective as possible. Each of the thirteen full-time instructors must have college-level education courses, as well as extensive experience in the water supply field. The Extension Service maintains a laboratory on campus for advanced water problems. For standard demonstrations, the instructors use portable labs which they take with them to the field. Short schools are usually held in the evenings, to avoid interference with class members' jobs. During the day, the instructors work with the class members in the field, in order to observe first-hand the situations faced by the trainees and to make the instruction as individualized and pertinent as possible. The Extension Service has immediate feedback as to the effectiveness of their training sessions; about 80 percent of their students pass the TDH licensing test (24).

CASE STUDIES: APPROACHES TO THE PROBLEM

It is of interest to examine how the problem of information dissemination has been handled at the federal, state, and local levels. Below are brief descriptions of how three agencies have disseminated information on the Act and water-related topics. Table 3-3 summarizes the media activities of these campaigns.

Environmental Protection Agency

When the issue of primacy was being debated in New Mexico, EPA funded an information campaign to lobby for its passage. Among the components of the statewide advertising "blitz" were:

- a 30-minute film entitled "Is Your Drinking Water Safe?";
- a 30-minute television show, which was shown on both public and private stations;
- 30-and 60-second radio and television public service announcements;
- organization of a speaker's bureau;
- press releases to most state newspapers; and
- brochures and pamphlets for mass distribution (25).

TABLE 3-3
AGENCY APPROACHES

Media	EPA	AACOG	PITLUK
Film	x		
Television	x		x
Public Service Announcements	x		x
Speakers	x	x	x
Newspapers	x		
Brochures	x		x
Informational Letters		x	
Public Relations Tours			x

Code:
EPA: Environmental Protection Agency
AACOG: Alamo Area Council of Governments
PITLUK: The Pitluk Group

Alamo Area Council of Governments

EPA funded the Alamo Area Council of Governments (AACOG) in San Antonio to inform the public about the Safe Drinking Water Act. Since the number of violators in the area is quite small, the campaign was modest. The method used was:

- AACOG members carefully screened the SDWA regulations to ascertain who would be affected by them;
- those who would be affected were categorized; because of limited funding, informational letters were sent to organizations which were asked to distribute them (another example of using "key officials"); and
- the information explained
  (a) the Act in lay terms
  (b) how it might affect the operator in question
  (c) what would constitute non compliance
  (d) what remedial options exist (26)

Pitluk Group

In a parallel program, EPA granted funds to promote section 208 of the Water Pollution Control Act (P.L. 92-500). Section 208 deals with waste water treatment planning. To handle this communication campaign, AACOG contracted with a San Antonio advertising agency, the Pitluk Group. The firm evaluated public participation activities and determined that the average citizen in Bexar County is uninformed about the issue, and would not come on his or her own incentive to community workshops and training sessions. Pitluk's 1977 summer campaign to increase public participation included:

- distribution of a brochure on 208 planning to interested persons via AACOG mailing lists*;
- development of simple graphic charts illustrating the 208 planning process, designated 208 areas, and affected streams and waste-water treatment plants;
- advertisements announcing upcoming public hearings;
- production of radio and television public service announcements;
- development of a television news service regarding 208 planning; and
- planning bus tours, to show key points of interest and areas affected by 208 to selected groups (27).

PROPOSALS FOR COMMUNICATION CAMPAIGNS

This final section formulates two proposals to reach the public with information about the Safe Drinking Water Act. One proposal is for an information campaign for a state agency to reach water suppliers. The second section suggests how an individual water supplier might effectively communicate with its customers. Table 3-4 lists the various communication media employed in these state and local level information campaigns.

State Level

Several methods have been used by state agencies to provide information regarding the Act, but communication remains inadequate. This section formulates a state-wide information campaign to improve the management of information relayed from the state to the water suppliers.

Listed below are components of a state-wide campaign. Depending on the situation, some elements may be emphasized and some deleted.

A first step would be to obtain a mailing list which includes all known water systems not in compliance with the Act. Key persons in the community, identified from previous contacts, should be listed. The number of contacts depends on the size of the community. For a trailer park or small community with fewer than fifty customers, the water manager would be the likely recipient of the information. If a community is larger, elected officials should also be contacted, since drinking water involves the health and safety of their constituents.

The state would send to each key person a series of pamphlets or booklets about the Act. These should include information regarding:

- the Act and its impact on Texas communities;
- the meaning of non-compliance and its administrative, financial, and technical ramifications;
- the basis for the MCL standards;
- the treatment options for reduction of contaminants; and
- the administrative options for gaining time (variances or exemptions) or joining with other communities (regionalization).

TABLE 3-4
OPTIONS FOR PUBLIC INFORMATION CAMPAIGNS

Local Level	State Level
Brochures	Brochures
Radio	Feedback cards
Television	Visiting engineers
Bill inserts	Short schools
Newsletters to customers and agency personnel	Newspapers
Public speakers	Public Service Announcements
Special exhibits	Radio
Contests	Television
Public Service Announcements	Film
Transportation Vehicles	

*Brochures were sent to banks, citizens' groups, public libraries, college campuses, club and organization offices, department stores, and inserted in City Public Service bills.

To obtain a sense of community understanding and response, the state should include a stamped, preaddressed feedback card, as shown in figure 3-1.

Following the distribution of the information packets, regional engineers would be requested to speak to system managers regarding the impact of the material. The engineers should be issued a copy of the feedback card or a short questionnaire which they could administer to the manager. The engineers would also be instructed to notify TDH, or the agency involved, of any obvious or potential problems. Beyond these visits, the state could integrate safe drinking water promotion into "short schools" and public relations activities. A short series of informational articles regarding the Act, in the form of news releases, could be prepared and sent to local newspapers. To develop and strengthen consumer interest and action, these news releases could be inserted one per day for a week-long drinking water "blitz".

Local Level

This section formulates a community-wide information campaign for a water system operator to explain the Act and what it means to consumers. The campaign utilizes the communications methods of (a) direct mail, which is immediate and tangible; (b) news media, which is wide-reaching; and (c) personal contact, which is forceful and personalized. The scale of the campaign will vary with each system (29).

Direct Mail

Bill inserts usually require no additional postage costs when bills are mailed in envelopes. The inserts should be kept short and simple—one or two pages. Photographs, cartoons, tables, graphs, and charts can be used to educate customers about the water system and how the Act affects it.

Newsletters require additional postage but have the advantage of carrying a larger amount of information. Also, newsletters can reach residents of apartment complexes who do not pay water bills, but who, as customers, are potential "watchdogs" for Act implementation.

News Media

Newspapers are especially useful if there is an editor or reporter "contact" so that the water agency's material can be printed. In some cases information can be relayed verbally to the contact, who can put it in its proper form. A member of the water supply agency should be trained in the preparation and distribution of news releases in standard newspaper format. It should be remembered that a single article, which can easily be overlooked, may be insufficient. A series of articles in combination with other media efforts is much more effective.

Radio and television is a more expensive form of communication, usually requiring professional services. The water supplier can utilize public service announcements, which are usually 30-second statements between programs. To prepare such ads, the agency might rely on donated help from public service directors of local stations or media classes in local high schools and colleges.

Public transportation vehicles, such as buses, taxis, and commuter trains, often have provisions for public service signs and posters. Contests can be held for the most effective signs and slogans, perhaps involving local high schools and college art departments. Youth groups, such as the Girl Scouts, will often assume such responsibilities as a public service.

Personal Contact

Telephone calls to water agencies occur continuously and thus are a constant source of public information. Water agency personnel should be well-versed so as to be able to

FIGURE 3-1
DRAFT LANGUAGE FOR 'FEEDBACK' CARD

We have received the packet of information about the Safe Drinking Water Act from the Texas Department of Health, and are returning this card with the following requests:

_____The material has been examined. Please send additional information about_____

_____

_____We are interested in having a regional representative come to address the community about_____

_____

_____The material has been received and no further information is needed.

courteously and efficiently answer customer's calls and complaints. In order to assure accurate communication, a factsheet could be distributed to assist workers in answering questions from neighbors and friends. Records should be kept of all calls received and contacts made to enable management to insure that there is no backlog of inquiries.

Public speakers can include water agency personnel armed with accurate information and relatively good speaking skills. Such persons can be effective communicators of agency issues and problems in dealing with the Act. Schools especially provide large audiences and students take the message home to their parents, thus indirectly enlarging the audience. Slides can be shown to increase the effectiveness of these encounters. Reinforcing educational materials, such as key rings, lapel buttons, and bumper stickers can be distributed to audience members.

Special events, such as exhibits in shopping malls and neighborhood community centers, can be used to put information directly into the hands of consumers. As with public speakers, there is also the potential for direct feedback. Other special events might include slogan and campaign contests, and community-wide demonstrations for safe drinking water (such as Earth Day or Solar Day).

REFERENCES

(1) Janak, John.
Telephone interview to the Lower Rio Grande Valley Development Association from Austin, Texas by Betty Rogers on October 28, 1977.

(2) Gaston, John.
"Consumer Notification-Public Awareness or the Smoking Pistol?", *Journal of the American Water-Works Association*, vol. 69, no. 11, November, 1977, p. 575.

(3) *Ibid.*

(4) Anon.
Southwest and Texas Water-Works Journal, vol. 10, no. 3, November, 1977, p. 11.

(5) LBJ Safe Drinking Water Policy Research Project (1976-77)
Impact of the Safe Drinking Water Act on Texas, Austin, Texas: Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin, 1978.

(6) Bettinghaus, Erwin P.
Persuasive Communication, New York: Holt, Rinehart, and Winston, Inc., 1973, p. 156.

(7) *Ibid.*

(8) Lesly, Philip, ed.
Public Relations Handbook, New York: Prentice-Hall, Inc., 1955, p. 234.

(9) Janak, J., *op. cit.*

(10) Watkins, Gary.
Telephone interview to the Texas Municipal League from Austin, Texas by Betty Rogers on October 27, 1977.

(11) *Ibid.*

(12) Janak, J., *op. cit.*

(13) Higgins, Bobette.
"Financial Report on 'Project Safewater' ", Austin, Texas: Texas League of Women Voters, mimeo, 1977a.

(14) Higgins, Bobette.
"Final Report on 'Project Safewater' ", Austin, Texas: Texas League of Women Voters, mimeo, March 1, 1977b.

(15) *Ibid.*

(16) Higgins, Bobette.
Telephone interview from Austin, Texas by Betty Rogers, 1977c.

(17) Anon.
Reader on Water Quality, Austin, Texas: Texas Department of Water Resources, not dated.

(18) Anon.
Twenty Questions on Water Quality, Austin, Texas: Texas Department of Water Resources, not dated.

(19) Solsbery, Lee.
Interview with Betty Rogers in Austin, Texas on October 3, 1977.

(20) Farris, Jean.
Telephone interview to the Texas Department of Water Resources from Austin, Texas by Betty Rogers on October 27, 1977.

(21) Higgins, B., 1977c, *op. cit.*

(22) Lesly, P., *op. cit.*

(23) Anon.
"Water and Wastewater Training Division", College Station, Texas: Texas A&M University System course schedule, not dated.

(24) Mansfield, W.B.
Telephone interview to Texas A&M Engineering Extension Service from Austin, Texas by Betty Rogers on October 28, 1977.

(25) Williamson, Betty.
Telephone interview to the Environmental Protection Agency from Austin, Texas by Betty Rogers on October 28, 1977.

(26) Kachtik, June.
Telephone interview to the Alamo Area Council of Governments from San Antonio, Texas by Betty Rogers on October 2, 1977.

(27) Plum, Stephen H.
"Public Participation Activities," San Antonio, Texas: The Pitluk Group Advertising Agency, photocopy of memorandum, not dated.

(28) Eaton, David.
Memorandum to Betty Rogers of November 18, 1977 on the topic of this section.

(29) Lattie, John.
"When a Manager 'talks' to the Public," *Journal of the American Water-Works Association*, vol. 69, no. 11, November, 1977, pp. 580-583.

CHAPTER IV

WATER TREATMENT TECHNOLOGY FOR FLUORIDE AND NITRATE REMOVAL

INTRODUCTION

Modern technology provides the capability to prepare water for its many different uses in our daily activities. Advancements in the state of the art in water treatment technology and corresponding increases in treatment costs have come about rapidly. Though significant, cost is only one of the variables in decisions involving the preparation of water for domestic or industrial uses. Variables such as water quality and quantity required for the intended use must be considered in order to determine the most cost-effective mode of system operation.

The national drinking water standards require many small communities in Texas to re-evaluate their drinking water systems with respect to fluoride and nitrate contaminants. If fluoride or nitrate must be removed from a local water supply, one can either treat the target contaminant or remove all dissolved solids. The first approach, treating water to remove only fluoride and nitrate, involves single purpose treatment options such as coagulation-precipitation, ion exchange, or adsorption. The second approach, to remove total dissolved solids (TDS), includes removal of fluoride and nitrate. Reverse osmosis, electrodialysis, and demineralization are such TDS removal processes. Table 4-1 and the remainder of the paper provide an overview of the state of the art in water treatment technology for the removal of fluorides (F^-) and/or nitrates (NO_3^-) from a raw water supply (1,2). This paper discusses the technical bases, relative costs, and performance characteristics of these techniques.

REVERSE OSMOSIS

Water treatment by reverse osmosis is based on the process of diffusion of water through a semi-permeable membrane. A semi-permeable membrane is a sheet of organic molecules which allows the passage of water but retards the passage of dissolved substances present in the water (3). A similar process occurs in the membranes of all living things and is called osmosis.

Osmosis is a "natural equalizing process" (4). If a semi-permeable membrane separates two water solutions containing different concentrations of dissolved substances, diffusion tends to equalize concentration. For example, if a salt solution is separated from fresh water by a semi-permeable membrane, water will flow from the fresh water side through the membrane to dilute the salt water solution. The flow will continue until the solutions are at equilibrium (5). The pressure of water seeking to equalize concentrations is called osmotic pressure.

The concept of reverse osmosis is to force the water to flow from the salt solution to the pure water solution. This is achieved by subjecting the salt solution to a pressure which is greater than the natural osmotic pressure. The semi-permeable membrane will allow the pure water to flow through but will not allow the passage of salt.

This process will work for any dissolved constituent in the water. The rate of pure water flow through the membrane is a function of the difference between the applied pressure and the natural osmotic pressure of the water. Pressure applied to the contaminated water (feedwater) increases production of pure water (product water). Generally, it takes about 10 milligrams per liter (mg/l) of dissolved solids to create one pound per square inch (psi) of osmotic pressure (6). For best results, reverse osmosis units operate at 5 to 50 times the osmotic pressure of the feedwater (7).

The two types of reverse osmosis units most often used are the spiral wound and hollow fiber types. A spiral wound unit consists of a membrane sheet rolled into a spiral configuration and placed in a sealed pipe about 8 inches in diameter and 8 feet long. This allows for a large surface area within a relatively small section of pipe. The feedwater enters one end of the pipe and flows over the surface of the spiral membrane. The product water permeates the membrane and is collected in a perforated effluent pipe located in the center of the membrane roll. The brine continues to flow through the tube, and is collected at the opposite end, as illustrated in figures 4-1A and 4-1B (8).

From the outside the hollow fiber unit looks much like the spiral wound unit. The major difference is that a hollow fiber achieves a large surface area through a configuration of a bundle of long membrane fibers in a pipe. As the feedwater enters one end of the pipe, it flows over the bundle of fibers. The product water permeates the fibers and flows to one end of the pipe where it is collected at the opposite end as illustrated in figure 4-1C.

TABLE 4-1: SUMMARY OF TREATMENT PROCESSES

Process	Operational Characteristics	Application
1. *Reverse Osmosis*	(1) Membrane technique (2) Reject dissolved solids (3) NO_3^- removal–90% (4) F^- removal–90% (5) Good for high TDS water	(1) Remove NO_3^- and F^- nonselectively
2. *Electrodialysis*	(1) Membrane technique (2) Rejects dissolved ions (3) NO_3^- removal at least 50% (4) Good for high TDS water	(1) Removes NO_3^- nonselectively
3. *Selective Ion Exchange*	(1) A replacement reaction (2) Media requires regeneration with chemicals (3) Specific resins can replace only NO_3^- with Cl^- (4) Best on low TDS water	(1) NO_3^- selectively removed
4. *Demineralization*	(1) Removes all cations and anions (2) Media requires regeneration with chemicals	(1) Removes NO_3^- and F^- nonselectively
5. *Activated Alumina*	(1) A replacement reaction (2) Media requires regeneration with chemicals or replacement (3) Specific resin replaces only F^- with OH	(1) Removes F^- selectively
6. *Tri-calcium Phosphate*	(1) Replaces only F^- by OH (2) No TDS removal (3) Resin either regenerated or replaced	(1) Selective F^- removal
7. *Denitrification*	(1) Removes NO_3^- by bacteria action (2) No TDS removal (3) Needs added substrate source for bacteria to grow	(1) Removes NO_3^- selectively
8. *Chemical Precipitation*	(1) Remove F^- during the lime softening process (2) High concentrations of Mg^{++} must be present (3) Large quantity of lime sludge to dispose of	(1) Removes F^- nonselectively

Source: Bernard Johnson, Inc., *Economic Impact of the Safe Drinking Water Act (PL 93-523) on the State of Texas*, Houston, Texas: Bernard Johnson, Inc., August 1977.

FIGURE 4-1A
RO SPIRAL-WOUND MODULE CONFIGURATION

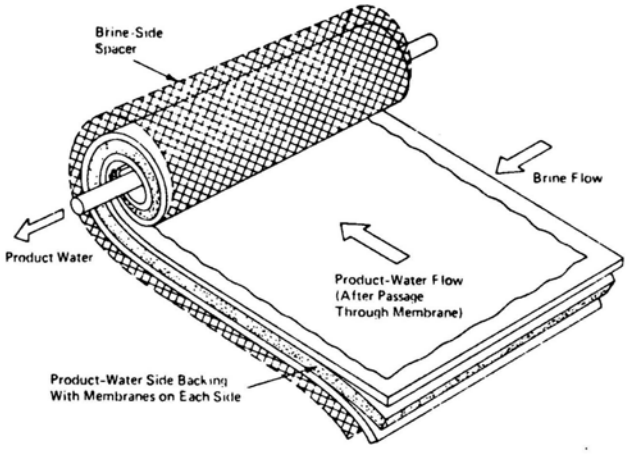


FIGURE 4-1B: CUTAWAY DETAILS OF SPIRAL-WOUND CARTRIDGE CONSTRUCTION

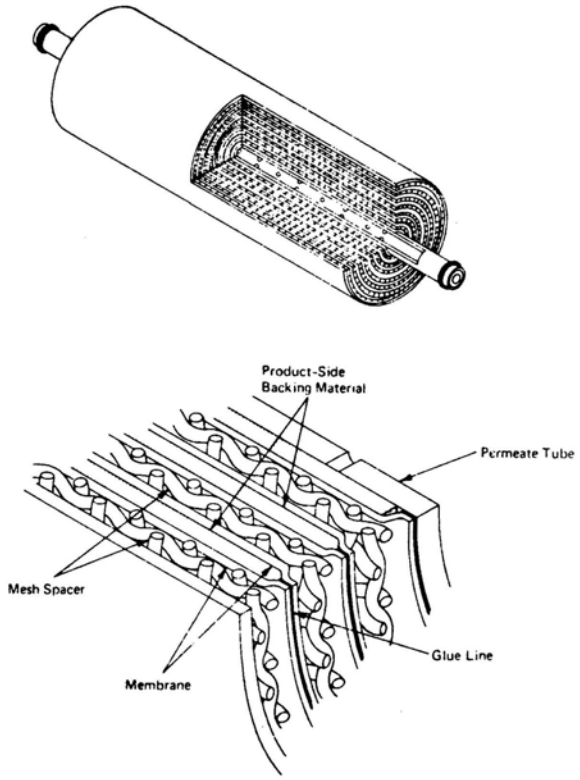
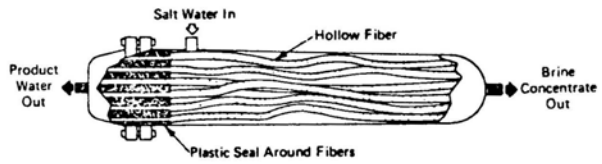


FIGURE 4-1C
ILLUSTRATION OF HOLLOW FIBER RO UNIT



Source: Lynch, Maurice A. Jr. and Mintz, Milton S., "Membrane and Ion Exchange Processes–A Review," *Journal of the American Water Works Association*, AWWA, Denver, Colorado, v. 64, no. 11, November 1972, p. 711. Reprinted with permission of the American Water Works Association, copyrighted 1972.

Pretreatment

Pretreatment of the feedwater is important in reverse osmosis treatment. If the feedwater is not properly pretreated, the membrane may be fouled or destroyed as the feedwater contacts the membrane. Maintenance costs escalate when the system must be shut down for cleaning or replacement of membranes due to fouling. Fouling is the gradual buildup of solids which are present or precipitate and deposit on the membrane. Fouling blocks the surface and reduces the membrane's effectiveness. Materials that can foul a membrane include heavy metals, colloids, calcium carbonate, calcium sulfate, organic materials, and biological growths (9).

Pretreatment unit operations include chemical addition, water softening, ion exchange, pH control, and filtration. There are two basic approaches to pretreatment. One method is to precipitate the hardness (calcium and magnesium compounds) to prevent fouling or scaling of the membrane. The other approach is to add chemicals which do not remove the hardness but instead keep it in solution at higher than saturated (supersaturated) levels. A common strategy for pretreating groundwater can involve the following steps (10,11):

1. Keep air out of the pipe that leads from the well to the treatment plant. Absence of air keeps iron from oxidizing to a form which can later precipitate and foul a membrane.

2. Add sulfuric acid to lower the pH to between 5.7 and 7.5 to prevent the precipitation of calcium and magnesium.

3. Add sodium hexametaphosphate to stabilize magnesium and iron to prevent precipitation.

4. As an alternative, add potassium permanganate to oxidize iron and manganese. Then a coagulant can be added to settle out oxides and clays.

5. Use ion exchange to remove hardness caused by calcium and magnesium.

Treatment and Post-Treatment

After pretreatment, the feedwater enters the reverse osmosis unit. Many factors influence the design of a reverse osmosis unit. These include operation pressure, temperature, pH, chlorine concentration, and conversion rate.

Reverse osmosis is energy intensive because high pressure centrifugal pumps are needed to raise the pressure of the feedwater to about 400-600 psi inside the unit. Between 8 to 12 kilowatt hours per 1,000 gallons of treated water may be needed to achieve such pressures. Over a period of time the membrane will compact under these operating pressures, causing a reduction in the permeation rate (flux) and rejection efficiency (12). High operating pressure causes more rapid compaction of the membrane. Consequently, manufacturers will usually guarantee the membranes only for three years.

Temperature is another important design factor. Most units operate best at temperatures between 60 to 95 degrees Fahrenheit (15-35 degrees Centigrade) (13,14). High temperature is detrimental because it increases the rate of compaction of the membrane. As water temperature increases one degree, the flux rate increases 2 percent. The optimum temperature is about 77 degrees Fahrenheit (25 degrees Centigrade) (15).

A third design consideration is water acidity or alkalinity (pH). Cellulose acetate membranes dissolve in water at high pH levels causing a decrease in salt rejection capacity. Hydrolysis is minimized when the system is operated at a pH of about 5.0 (16,17).

Another important consideration is the chlorine concentration of the feedwater. Chlorine reacts with reverse osmosis membranes and adversely affects the usefulness of the membrane. A maximum concentration of about 0.5 to 1.0 mg/l chlorine can be tolerated in the feedwater (18).

Conversion rate is a final design factor. Most units are operated at a sufficient pressure to produce 75 to 80 litres of product water for every 100 litres of feedwater (19). Added pressure can increase the conversion rate but also will result in added energy costs and membrane compaction.

Table 4-2 lists performance results from reverse osmosis applications at a number of installations. A typical rejection efficiency for a reverse osmosis unit is about 88 percent to 95 percent for fluorides, 60 percent to 90 percent for nitrates, and 90 percent for TDS (20,21). Nitrate removal is strongly pH dependent, with the result that removal efficiency varies widely.

These high removal efficiencies allow reverse osmosis units to achieve EPA drinking water standards even when the groundwater source contains as much as 28 mg/l of fluoride and/or 180 mg/l of nitrate. TDS in feedwater at levels above 4,000 mg/l can be treated to yield a product with TDS concentrations below the 500 mg/l 1962 Public Health Standard, as illustrated in Table 4-2 (22).

Water suppliers might want to post-treat their supply to improve the quality of delivered water after the reverse osmosis process. Typical post-treatment options are: (a) degasify the effluent to remove carbon dioxide and hydrogen sulfide; (b) post-filter water to remove suspended solids, particularly if high quality product water will be blended with untreated feedwater; (c) chlorinate the effluent to control bacteria in the distribution system; and (d) raise the pH to avoid acid corrosion of equipment and pipes (23).

ELECTRODIALYSIS

The electrodialysis process also uses a semi-permeable membrane to remove dissolved salts from water. Instead of using membranes which reject dissolved solids, as in reverse osmosis, electrodialysis membranes permit the passage of salts (electrically charged particles) selectively. Since most dissolved solids occur in the form of ions, electrodialysis is a good method to remove some dissolved solids. A review of the literature has not shown that electrodialysis is effective for removing fluorides. Consequently, this section only considers electrodialysis as a treatment method for nitrate and total dissolved solids.

In electrodialysis, the feedwater flows between stacks of alternating cation (positive) and anion (negative) selective membranes (27). When a direct electrical current is applied to the stack, cations and anions in the water migrate to the negatively and positively charged membranes respectively. Since the membranes are selective to cations or anions only, the dissolved salts in the water collect in waste brine layers. The entire stack will be composed of alternating layers of waste brine and purified water, as shown in figure 4-2 (28).

The rate of purification is directly proportional to the amount of electric current applied. The membranes are placed 0.03 to 0.04 inches apart to minimize electrical resistance (29) and produce the maximum purification. A typical electrodialysis unit uses between 7 and 15 kilowatt hours to purify 1,000 gallons of water (30). The higher the amount of dissolved solids in the water, the more energy is required for purification (31).

As with reverse osmosis, pretreatment is employed to increase the life expectancy of the membranes. A water analysis is first conducted to determine the proper pretreat-

TABLE 4-2: REVERSE OSMOSIS PERFORMANCE DATA**

Location	Date	Capacity (gpd)	Feed (mg/l TDS)	Product (mg/l TDS)	Efficiency (% removal)	Conversion Rate (%)	Operating Cost ($/1000 gal.)	Cost: $/1000 gal. /1000 mg/l TDS removed	Reference
Greenfield, Iowa	5/71	150,000	2,200	200	91%	67%	.30	.15	(24)
Rotunda, Florida	10/72	500,000	6,300	380	94%	50%	.65	.12	(24)
Leed, North Dakota	9/74	100,000	4,200	350	92%	80%	.30	.08	(24)
Siesta Key, Florida	12/74	600,000	1,500	150	90%	75%	.60	.44	(24)
South Caicos, Bahamas	3/75	5,300	42,000	435	99%	25%	9.88	.24	(24)
San Diego, California	4/72	50,000	4,500	310	97%	75%	–	–	(25)
Lakota, North Dakota	†	130,000	1,754	157	91%*	77%	1.56	.97	(26)
Eureka, South Dakota	†	340,000	2,163	456	80%*	88%	.80	.47	(26)
Sibley, Iowa	†	450,000	2,720	263	90%*	80%	.82	.33	(26)
Freer, Texas	†	440,000	1,242	341	73%*	90%	.79	.88	(26)
Malta, Montana	†	880,000	969	261	73%*	88%	.69	1.35	(26)
Fort Lupton, Colorado	†	1,860,000	1,423	258	82%*	86%	.60	.52	(26)
Fort Stockton, Texas	†	3,000,000	1,796	270	85%*	84%	.66	.43	(26)
Kihei, Hawaii	†	3,200,000	1,100	500	55%*	90%	.41	.68	(26)
Casa Grande, Arizona	†	4,380,000	945	220	77%*	89%	.49	.68	(26)
Midland, Texas	†	5,440,000	1,135	370	67%*	92%	.37	.48	(26)
Arkansas City, Kansas	†	5,750,000	1,658	323	81%*	87%	.52	.39	(26)
Artesia, New Mexico	†	7,180,000	941	160	83%*	85%	.48	.61	(26)

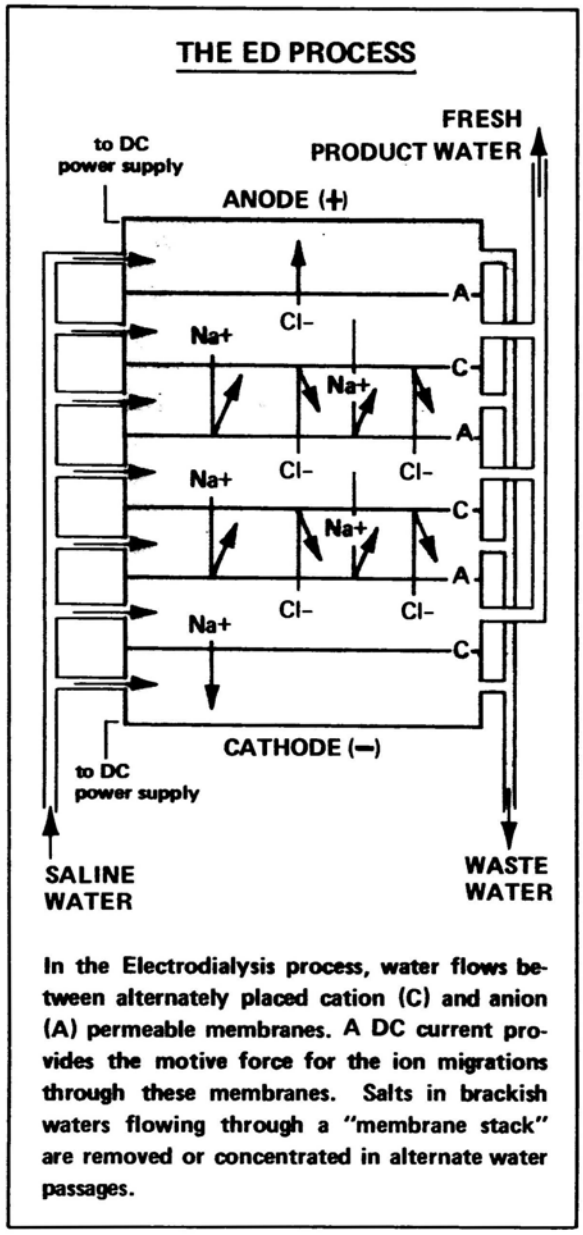
† Projected plants not yet constructed

* This value is the efficiency needed to produce a water with the quality listed.

**Performance has been based on TDS removal only. No data have been found that are based on fluoride or nitrate removal.

Sources: Doud, Donald H., "Field Experience With Five Reverse Osmosis Plants," *Water and Sewage Works*, v. 123, no. 6, June 1973, p. 75.
Cruver, James E., "Reverse Osmosis–Where It Stands Today," *Water and Sewage Works*, v. 122, no. 10, October 1973, p. 75.
Miller, E.F., "Demineralization of Brackish Municipal Water Supplies–Comparative Cost," *Journal of the American Water Works Association*, v. 69, no. 7, July 1977, p. 349.

FIGURE 4-2: THE ELECTRODIALYSIS PROCESS



Source: Ionics, Incorporated, "Aquamite XX," *Ionics*, Watertown, Massachusetts: Product information bulletin, no. 103, June 1976.

ment scheme. The pretreatment process options for electrodialysis are similar to those of reverse osmosis. These operations include coagulation of colloids; oxidation for iron, manganese, and soluble organic compounds; filtration through sand, carbon, or filter cartridge; removal of hydrogen sulfide and chlorine; and acid addition (32). A combination of these pretreatment options should assure longer membrane life and less maintenance.

Membranes are an important consideration in electrodialysis process design. Electrodialysis membranes can last up to ten years while reverse osmosis membranes have about a three year life. Temperature and pH have less of an effect on electrodialysis membranes. They are able to operate at a feedwater temperature of 110 degrees Fahrenheit (43 degrees Centigrade) and a pH of 6 to 9 (33). This greater life and tolerance of electrodialysis membranes is attributable to the fact that they are made of a different material and are installed in a different configuration than reverse osmosis membranes. The stacked configuration enables them to be assembled in the field and makes cleaning easier.

Another advantage of electrodialysis is the ease of removal of scale that may accumulate on the membranes; this can be done without disassembling the membrane stacks. Manufacturers report that the scale may be removed by reversing the polarity of the electrodes inside the membrane unit. Reversal of polarity reverses the flow of water and dissolved solids; it forces scale from the membranes into the brine water. Thus electrodialysis membranes do not experience the scale buildup and compaction of reverse osmosis membranes.

Electrodialysis systems have been reported to have good removal of TDS and fair removal of nitrate ions. The removal efficiency for TDS is 80 percent to 95 percent, or as good as some reverse osmosis systems (34). One author expects that electrodialysis could be expected to remove at least 50 percent of nitrates in feedwater (35).

As with reverse osmosis units, electrodialysis can yield about 72 litres of product water for 100 litres of feedwater, at average brackish groundwater concentrations (2500 mg/l of total dissolved solids). Some package treatment units have small conversion rates of approximately 60 percent (36). The conversion rate is influenced by the concentration of total dissolved solids; an increase of TDS in the feedwater decreases the recovery of product water. A 60 percent conversion rate implies that nearly 40 percent of the total feedwater flow is waste brine which presents a disposal problem. Post treatment processes, such as post-filtration and chlorination, are similar to those used for reverse osmosis.

OPERATION AND RESIDUALS OF REVERSE OSMOSIS AND ELECTRODIALYSIS

Because reverse osmosis and electrodialysis yield a high quality product water, an operator has flexibility in treatment options. When effluent levels of contaminants are low, an operator can blend a portion of untreated influent with treated effluent. Treating only a portion of the inflow can reduce cost. A common advantage of electrodialysis and reverse osmosis is that both systems can be fully automated.

A major problem common to the design of either system is waste disposal. Each process creates a concentrated waste stream that has a volume of about 25 percent to 40 percent of the feedwater. Disposal of this brine may add significantly to the operating cost of the system. One cost-effective brine disposal method open to some communities is to treat the brine in the municipal waste water treatment facilities. Small community wastewater treatment plants, however, might not be able to handle the increases in flow and high concentration of salts. Ocean discharge is an alternative for Texas communities located near the coast. If the wastes contain only salt brines, they would be similar to the salt water environment of the coastal waters, and could possibly be discharged without extensive additional treatment. Some brines may be used as ion exchange regenerants and in glass wool manufacturing. Although these two alternatives are technically feasible, they are not widely used (37).

Deep well injection is another disposal mechanism that has been used. In this procedure a well is driven below the water bearing strata and the waste brine is pumped into the ground. This alternative is costly due to high pumping pressures required and the original cost to sink the well. There can also be problems due to possible contamination of the groundwater. These problems may render this alternative unattractive.

Land disposal is another alternative for communities in Texas. The brine may be piped to a large shallow pond where the water is allowed to evaporate. The dried salts are collected and can later be removed and sent to landfills. This option is attractive in many areas in Texas where land may be inexpensive and the climate is conducive to high rates of evaporation.

ION EXCHANGE

Ion exchange is the displacement of one ion by another. As applied to water treatment, it may be defined as a reversible exchange of ions between a liquid and a solid without a change in the physical structure of the solid. The ion exchanger, or solid body, must have ions of its own to exchange for others (38). Ion exchange is commonly used for softening a hard water or demineralizing water. Demineralization is accomplished by using a combined process of hydrogen ion exchange followed by a hydroxide ion exchange (39).

There are two main types of exchangers, cation exchange (base exchange) and anion exchange (acid exchange). Zeolites were the first materials used as base exchange (40). Currently, synthetic resins, rather than natural or synthetic zeolites, are usually used.

Part of an ion exchange process is the regeneration of the resin. The frequency of regeneration depends on size of the resin bed or column stack, type of resin used, quality and rate of raw water fed, type of regenerator used, and objective of the process–whether to soften or demineralize. Resins last longer in softening uses than in demineralization.

Cation exchange resins of the sulfonated styrene-divinylbenzene type are preferred for most water softening using ion exchange. These resins, such as Amberlite IR-120 and Amberlite 200, are quite stable and exhibit high exchange capacities and regeneration efficiencies using brine as the regenerator. Amberlite 200 is a resin of large porous organic molecules that are physically and chemically stable enough for operation of high temperatures or with waters containing a potentially high oxidizing power. For special conditions, carboxylic cation exchange resins such as Amberlite IR-50 and Amberlite IRS-84 are used. These are rarely used for water softening because they have an unusually high selectivity for hardness. This has stimulated interest in their use in removing the last traces of hardness to finish water to 1 mg/l or less of hardness. Carboxylic cation ion exchangers use a two step regeneration procedure because they cannot be regenerated efficiently with a brine solution due to their high selectivity for hardness (41).

Ion exchange has been used to remove fluoride (F^-) and nitrate (NO_3^-) ions from raw water. Fluoride exchangers are anion exchangers that consist of a processed tri-calcium phosphate. They function in much the same way as protein-free bone to remove fluorides from solution. These exchangers have an exchange capacity of 0.4-0.9 kilograms of fluoride per cubic foot of exchangers at a sodium hydroxide dosage of 0.64 to 1.5 kilogram NaOH per kilogram of fluoride removed (42). Nitrate has been removed effectively by demineralization.

Ion exchange can be an expensive process. A controlled experiment compared capital, operating, and maintenance costs to remove nitrates using ion exchange, reverse osmosis, and electrodialysis. The study found that the least costly was electrodialysis at 22.0 cents per 1,000 gallons, followed by ion exchange at 30.3 cents per 1,000 gallons, and reverse osmosis at 55.0 cents per 1,000 gallons (43).

The operation of ion exchange equipment requires specially trained personnel. Training includes: (a) basic

TABLE 4-3: ELECTRODIALYSIS PERFORMANCE DATA**

Location	Date	Capacity (gpd)	Feed (mg/l TDS)	Product (mg/l TDS)	Efficiency (% removal)	Conversion Rate (%)	Operating Cost ($/1000 gal.)	Cost: $/1000 gal. /1000 mg/l TDS removed	Reference
Sibley, Iowa	†	450,000	2,720	263	90%*	80%	1.91	.78	(35)
Freer, Texas	†	440,000	1,242	341	73%*	90%	1.05	1.16	(35)
Fort Stockton, Texas	†	3,000,000	1,796	270	85%*	84%	.75	.49	(35)
Kihei, Hawaii	†	3,240,000	1,100	500	55%*	90%	.75	1.25	(35)
Casa Grande, Arizona	†	4,380,000	945	220	77%*	89%	.50	.69	(35)
Arkansas City, Kansas	†	5,750,000	1,658	323	81%*	87%	.53	.40	(35)

† Projected plants not yet constructed.

* This value is the efficiency needed to produce a water with the quality listed under the Product column.

**Performance has been based on TDS removal only. No data have been found that are based on nitrate removal.

Source: Miller, E.F., "Demineralization of Brackish Municipal Water Supplies–Comparative Cost," *Journal of the American Water Works Association*, v. 69, no. 7, July 1977, p. 349.

technical knowledge of the unit process; (b) skills in the chemical tests necessary for process control; (c) safety instructions to handle the acid and caustic materials required for regeneration; and (d) procedures to safely dispose of the waste waters produced by the ion exchangers (44).

DEMINERALIZATION

To demineralize water is to remove all ions of inorganic salts. Dealkalization is a process used to remove carbonates and bicarbonates of calcium, sodium, and magnesium (45). The costs to demineralize sea water or brine by ion exchange may be too high to be practical due to the high total solids.* Demineralization, however, can be one of the most effective methods to obtain high quality product water for a municipal water system when feedwater contains less than 1,000 mg/l total dissolved solids (47).

To demineralize water, the water is first passed through a cation exchanger resin in the hydrogen form and an anion exchanger in the hydroxide form. A recent development is a single vessel containing a mixture of equal quantities of cationic and anionic exchange resins in a mixed bed. When a water containing fluoride and nitrate is fed through the demineralization process, the resultant product water will be low in TDS, fluoride, and nitrate. The quality of the product water depends upon the detention time in the demineralization column, the ion exchange capacity, and the quality of the raw water being processed (48).

ADSORPTION

Many materials have been investigated for their ability to remove fluoride by adsorption. Two materials, activated alumina and tricalcium phosphate (bone char), have been used successfully in full scale operations. Activated alumina seems to be more widely accepted in the literature than bone char for removal of fluoride from drinking water.

Activated Alumina

A plant in Bartlett, Texas used activated alumina to remove fluorides during the period of 1951 to 1977 (49). Activated alumina (calcined granules of hydrated alumina Al_2O_3) of a 28-48 mesh size was used. With the closing of the Texas plant, there are only two operating activated alumina defluoridation plants, one in Desert Center, California and the other at the X-9 Ranch near Tucson, Arizona. A new plant has been proposed for Gila Bend, Arizona (50).

A recent study of the Bureau of Engineering Research at the University of Texas at Austin evaluated three alternative processes to remove fluoride from water: (a) lime addition with magnesium precipitation; (b) adsorption on activated alumina; and (c) adsorption on activated bone charcoal. The study demonstrated that fluoride removal is technically feasible with all three processes. The study concentrated on two natural waters from Williamson County, Texas. The waters had similar ionic strengths and similar fluoride content, even though they were drawn from different depths (60 and 1,000 metres) and parts of the county (east and west, respectively). Hardness and total dissolved solids were much higher in the sample drawn from the shallow well and the predominant minerals in the waters were different. The authors found that activated alumina was more effective in removing fluorides from a sodium solution than from a natural water (51). The presence of bicarbonate, calcium and magnesium in water appreciably reduced the fluoride removal capacity of the activated alumina (52).

Activated alumina can exchange fluoride ions easily with a solution, since it is selective for fluoride. Its exchange capacity is related to the fluoride concentration, the pH of the treated water, and the amount of regenerant used. It is not affected by normal concentrations of salts (sulfates of chlorides) in water. Activated alumina's selectivity for fluoride is an advantage over a synthetic strong-base resin that may remove many anions.

One advantage of activated alumina is its relatively low cost, $12 to $14 per cubic foot, or about one tenth the cost of a synthetic anion resin and about one quarter the cost of bone char (53). One major disadvantage of activated alumina is that the regeneration process (similar to that used for bone char) uses caustic and acidic solutions. Such materials require careful control and handling by trained operators.

Tri-calcium Phosphate (Bone Char)

Bone char is a porous, amorphous solid of primarily tri-calcium phosphate and carbon that can be prepared from bones. The porosity and stable nature of bone make it valuable for adsorption. A principal source of information about full-scale bone char defluoridation is the Britton, South Dakota plant that operated from between 1953 and 1971 (54).

A potential complication is that bone char can remove arsenic from arsenic bearing waters as well as fluorides. Once the arsenic is adsorbed on bone char, it cannot be removed through the normal regeneration process with caustic solutions. This causes the fluoride capacity of the

*Brackish water contains dissolved solids (salts) in the range of 1,000-3,500 mg/l. Sea water contains about 35,000 mg/l of dissolved salts (46).

bone char to decrease with use; eventually the char must be replaced. Thus bone char is not practical for fluoride removal from waters that also contain arsenic.

DENITRIFICATION

Denitrification is a process by which denitrifying bacteria reduce nitrate to nitrogen gas. Water is passed through a biological filter bed, and the organisms in the biological slime use nitrate for metabolism. As the bacteria grow and reproduce, some of the organisms become detached from the filter bed; thus a conventional sand filter is needed to remove the carry-over bacterial growth (55). It is necessary to provide an organic energy source for the bacteria. Methanol is usually chosen as the most satisfactory and least expensive carbon source (56). Care must be taken not to overdose the bacteria. Another problem is that time is required to establish the biological population in the filter. If there should be a loss of the biomass for some reason, a denitrification unit can be out of service for several days (57). Although denitrification can technically be called a feasible alternative, these problems make it impractical at this time. Since no full scale systems are in operation, no cost data are available. More research is needed before denitrification can be used for public water supplies (58).

CHEMICAL PRECIPITATION

Conventional lime softening is a feasible method to remove fluoride. It has been shown that substantial amounts of fluoride are removed along with magnesium during the lime softening process (59). The decrease in fluoride is a function of the magnesium removed; one mg/l of fluoride is removed for each 45 to 65 mg/l magnesium removed (60). If sufficient amounts of magnesium are not present in the water, a magnesium salt must be added before softening to achieve the desired fluoride removal.

Precipitation creates large amounts of lime sludge. Due to the sludge problem, the firm of Bernard Johnson, Inc., has suggested that use of lime softening may be limited to water supplies with fluoride concentrations below 2.5 mg/l and magnesium concentrations above 75 mg/l (61).

TREATMENT COST

The two basic approaches to fluoride and nitrate removal, removal of targeted contaminants or all dissolved solids, incur different treatment costs. Removal of a single contaminant from water reduces the concentration of either fluoride or nitrate. TDS removal not only reduces fluoride and nitrate, but may also increase the overall quality of the water by removing dissolved solids. The removal of all dissolved solids can save the consumer money by avoiding hidden costs associated with poor quality water. These costs include: (a) the cost of bottled water, home water softeners, or water conditioning agents; (b) the cost of excess soap and detergent use; and (c) the repair and replacement costs of appliances, plumbing fixtures and facilities due to corrosion and scale buildup (62).

The total of these hidden costs could amount to as much as $15 to $20 per month for a family of four (63). In some cases the cost of reverse osmosis or electrodialysis treatment could be $15 to $20 per month for an average family (64). Therefore, treatment of the water might not add incremental costs to the consumer; it could save money. These savings do not include benefits that are not easy to price, such as the value of treated water for the preparation and taste of food, the appearance of beverages, laundry, and cookware, and the overall satisfaction of water customers (65). Higher quality municipal water might even attract new residents or industries to a region. Since increased water quality may be associated with an increase in water demand (66), the design of water treatment facilities should take into account possible increases in water consumption.

The cost curves of figures 4-3 and 4-4 compare the capital costs (67, 68, 69, 70) and annual operating costs (71, 72, 73, 74) for the treatment options at various product water flow rates. The assumed interest rate was 7.50 percent. Because costs depend on local conditions which include labor costs, interest rates, and feedwater quality, the cost curves should only be used as approximate estimates of possible community costs associated with water quality improvements.

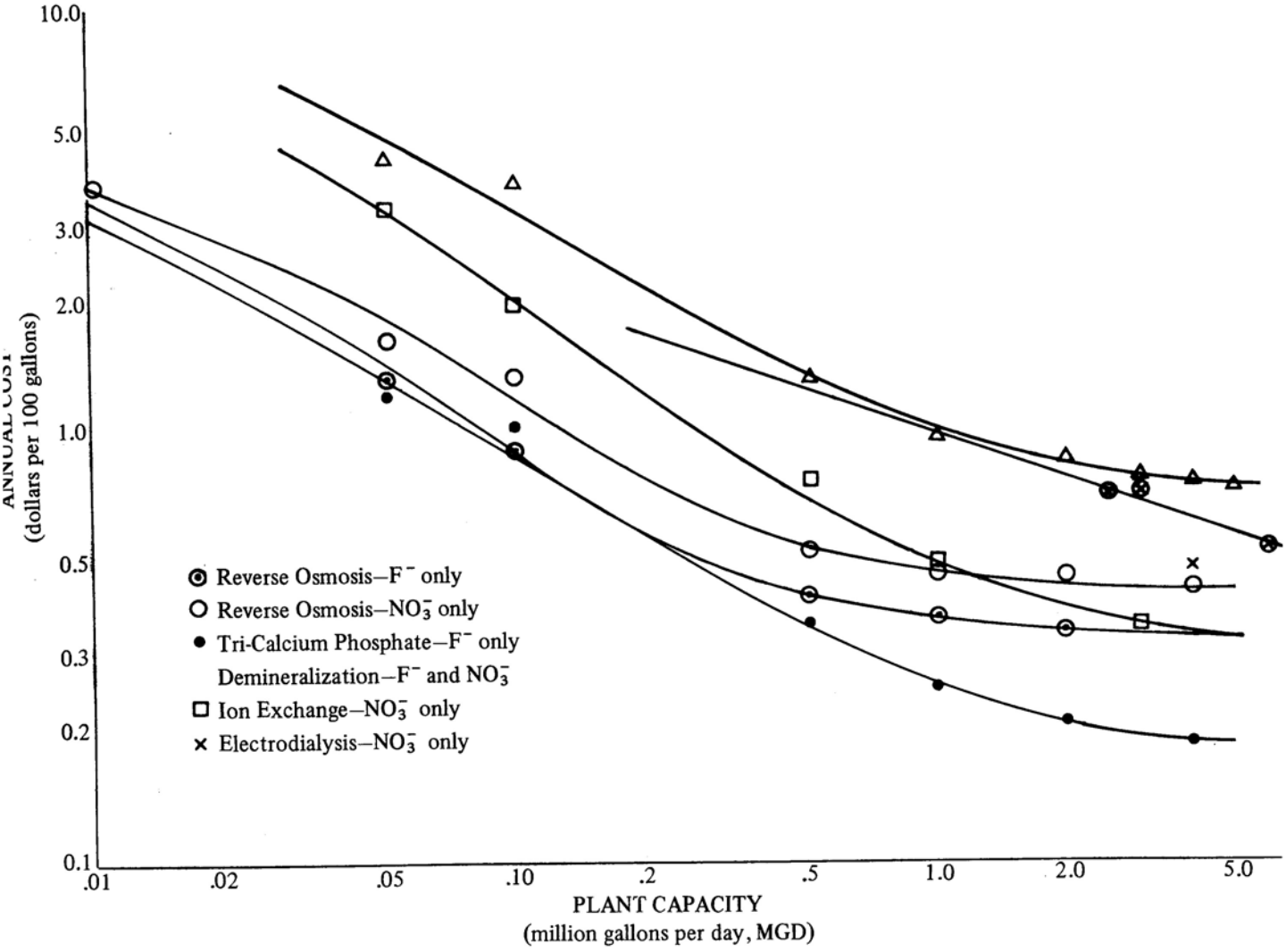
ILLUSTRATIVE EXAMPLES

Two examples have been developed to enable potential water suppliers to examine costs associated with treatment to remove fluoride or nitrate from drinking water. Case I and II are hypothetical situations where fluoride and nitrate, respectively, are to be reduced in the water supply. The key factors influencing costs in both cases are (a) community size, (b) amount of contaminant reduction, (c) treatment facility size and capacity, and (d) the treatment process. The particular hypothetical facts serve only to illustrate a typical cost calculation. Communities wishing to evaluate local problems would be well advised to seek appropriate engineering advice.

Case I

A community in Texas of 1,000 population uses groundwater which contains 2 mg/l of fluoride. They have decided to evaluate the alternative processes which can yield a product water that can meet the EPA standard for

FIGURE 4-3: ANNUAL PRODUCTION COSTS*



*Costs include pretreatment equipment, operation, maintenance, amortization, and blending of untreated influent with treated effluent

Note: Curves are best fit and are based on 1977 dollars,
Raw water quality of 1250 mg/l TDS
Nitrate–influent 86 mg/l treated to 45 mg/l as NO_3^-
Fluoride–influent 2 mg/l treated to 1.4 mg/l as F^-

References: (*62*) (*63*) (*64*) (*65*)

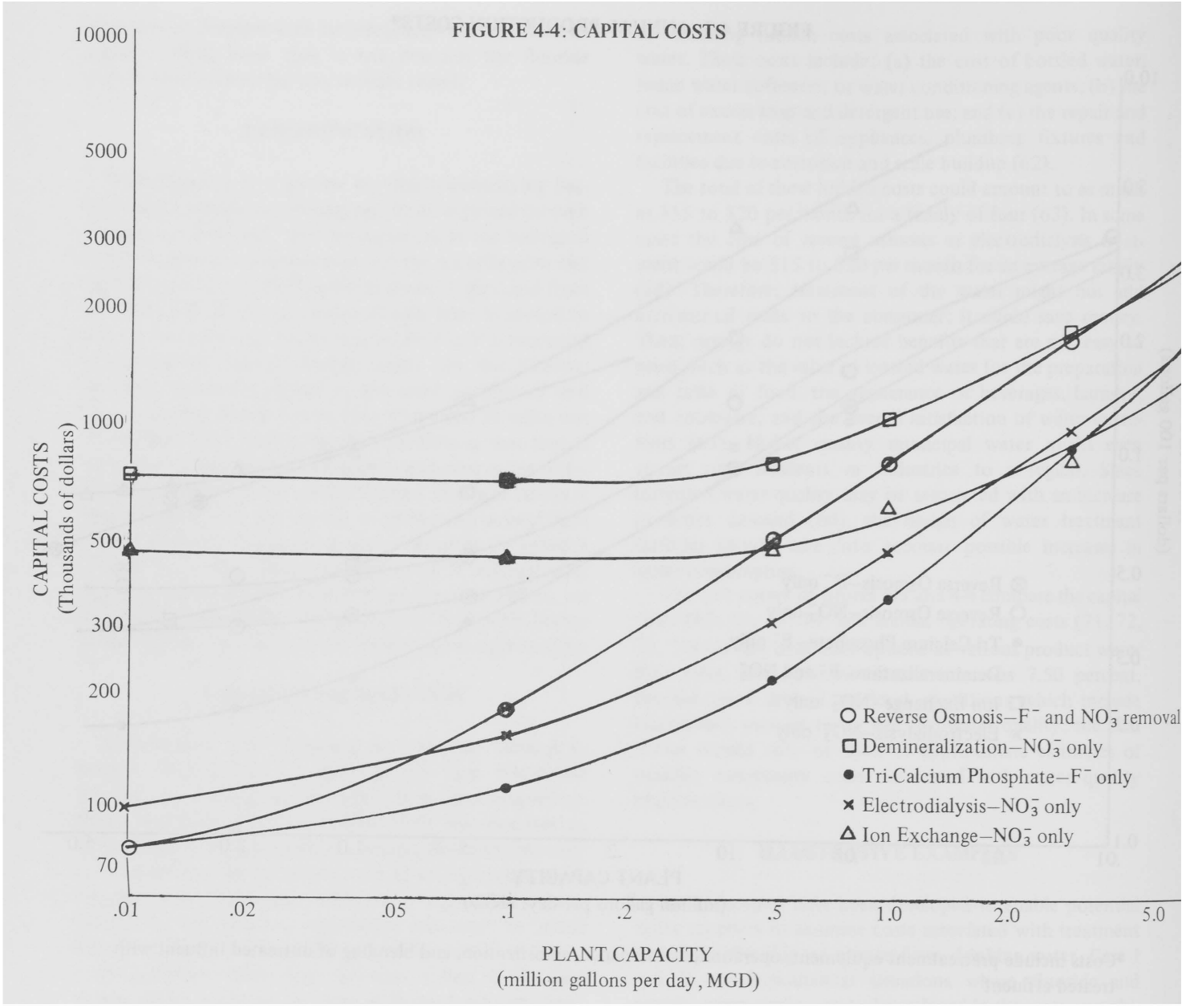
Sources: Miller, E.F., "Demineralization of Brackish Municipal Water Supplies–Comparative Cost," *Journal of the American Water Works Association*, v. 69, no. 7, July 1977, p. 349.

U.S. Environmental Protection Agency, *Manual of Treatment Techniques for Meeting the Interim Primary Drinking Water Regulations*, Cincinnati, Ohio: U.S. Environmental Protection Agency, May 1977, pp. 20, 28.

Mattson, Melvin E., "Membrane Desalting Gets Big Push," *Water and Wastes Engineering*, v. 12, no. 4, April 1977, p. 40.

Bernard Johnson, Inc., *Economic Impact of the Safe Drinking Water Act (PL 93-523) on the State of Texas*, Houston, Texas: Bernard Johnson, Inc., August 1977.

FIGURE 4-4: CAPITAL COSTS



*Costs include pretreatment equipment and blending of untreated influent with treated effluent

Note: Curves are best fit and are based on 1977 dollars,
Raw water quality of 1250 mg/l TDS
Nitrate–influent 86 mg/l treated to 45 mg/l as NO_3^-
Fluoride–influent 2 mg/l treated to 1.4 mg/l as F^-

References: (*66*) (*67*) (*68*) (*69*)

Sources: Faber, Harry A. and Sidney A. Bressler, "Improving Community Water Supplies With Desalting Technology," *Journal of the American Water Works Association*, v. 64, no. 11, November 1972, pp. 723-725.

Miller, E.F., "Demineralization of Brackish Municipal Water Supplies–Comparative Cost," *Journal of the American Water Works Association*, v. 69, no. 7, July 1977, p. 349.

Mattson, Melvin E., "Membrane Desalting Gets Big Push," *Water and Wastes Engineering*, v. 12, no. 4, April 1977, p. 40.

Bernard Johnson, Inc., *Economic Impact of the Safe Drinking Water Act (PL 93-523) on the State of Texas*, Houston, Texas: Bernard Johnson, Inc., August 1977.

their area, 1.4 mg/l of fluoride. Their water consumption is 100,000 gallons per day. Assuming a plant capacity of 0.10 million gallons per day and unit cost information from figures 4-3 and 4-4, table 4-4 shows the resultant costs. On the basis of calculated annual costs alone, either reverse osmosis or tri-calcium phosphate treatment options would be chosen before demineralization. If the feedwater is high in TDS, reverse osmosis treatment might be the best alternative because it can remove both TDS and fluoride.

Case II

A community in southwest Texas has a population of 1,000 persons and a water demand of 100,000 gallons per day. Their existing groundwater contains 86 mg/l nitrates. To meet the EPA nitrates standard (45 mg/l), the city must treat their water. Assuming a plant capacity of 0.10 million gallons per day and using unit cost data from figures 4-3, and 4-4, table 4-5 shows the treatment options and their respective costs. On the basis of annual costs alone, reverse osmosis would be the best treatment option. Ion exchange is the second choice because it is more costly and would remove less dissolved solids than reverse osmosis.

SUMMARY

There are many available processes that remove fluoride and nitrate from drinking water supplies. Reverse osmosis and demineralization can remove both fluoride and nitrate nonselectively. Electrodialysis removes nitrate nonselectively and chemical precipitation removes fluoride nonselectively. Selective removal of nitrate can be accomplished via ion exchange or denitrification. Adsorption using activated alumina or tri-calcium phosphate (bone char) can selectively remove fluoride.

These processes can be costly to install or operate. Each is complex enough to warrant an engineering design prior to installation. Operating personnel will require training in order to effectively operate and maintain such systems. Waste disposal costs may increase the costs considerably and any residuals will have to be handled in accordance with EPA regulations in order to protect the environment.

This paper has introduced the alternative treatment processes and described how they perform in removing fluoride and/or nitrate from water supplies. This information is a reflection of recent research and should not be considered as a guide to design of such water treatment systems. If a community decides to reduce either contaminant in its water supplies, the authors recommend that professional and technical guidance be sought for the assessment or design of community water treatment operations.

TABLE 4-4
HYPOTHETICAL COSTS FOR FLUORIDE REMOVAL*

Treatment Options	Capital Cost ($)	Annual Cost ($/yr.)
Reverse Osmosis	185,000	34,000
Tri-calcium Phosphate	115,000	34,000
Demineralization	no data	116,800

The annual cost of reverse osmosis involves multiplying treatment costs by plant capacity and by time in years:

$$\frac{\$0.94}{1{,}000 \text{ gallons}} \times \frac{100{,}000 \text{ gallons}}{1 \text{ day}} \times \frac{365 \text{ days}}{1 \text{ year}} = \frac{\$34{,}000}{\text{year}}$$

*Costs include pretreatment equipment, operation, maintenance, amortization and blending of untreated influent with treated product water. The curves are best fit and are based on 1977 dollars and a raw water quality of 1,250 mg/l TDS. Fluoride concentration is reduced from 2 mg/l influent to 1.4 mg/l as fluoride.

TABLE 4-5
HYPOTHETICAL COSTS FOR NITRATE REMOVAL*

Treatment Options	Capital Cost ($)	Annual Cost ($/yr.)
Reverse Osmosis	185,000	45,600
Ion Exchange	460,000	73,000
Electrodialysis	160,000	80,000
Demineralization	725,000	116,800

The annual cost of reverse osmosis involves multiplying treatment costs by plant capacity and by time in years:

$$\frac{\$1.25}{1{,}000 \text{ gallons}} \times \frac{100{,}000 \text{ gallons}}{1 \text{ day}} \times \frac{365 \text{ days}}{1 \text{ year}} = \frac{\$45{,}000}{\text{year}}$$

*Costs include pretreatment equipment, operation, maintenance, amortization and blending of untreated influent with treated product water. The curves are best fit and are based on 1977 dollars and a raw water quality of 1,250 mg/l TDS. Nitrate is treated from an influent concentration of 86 mg/l to a final concentration of 45 mg/l as nitrate.

REFERENCES

(1) Bernard Johnson, Inc.
Economic Impact of the Safe Drinking Water Act (PL 93-523) on the State of Texas, Houston, Texas, Bernard Johnson, Inc., August 1977.

(2) Sorg, Thomas J.
"Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics," *Journal of the American Water Works Association*, v. 70, no. 2, February 1978, pp. 105-112.

(3) Bernard Johnson, Inc., *op. cit.*, p. V-20.

(4) deBussy, Robert P. and Harold B. Whitmore
"Reverse Osmosis: Some Aspects of Industrial Water/Waste Treatment," *National Engineer*, v. 80, no. 10, October 1976, p. 125.

(5) Askim, Mary K. and Coila M. Janecek
"Reverse Osmosis Can Increase Supply and Quality of Potable Water," *Water and Sewage Works*, v. 123, no. 10, October 1976, p. 76.

(6) Lynch, Maurice A., Jr. and Milton S. Mintz
"Membrane and Ion Exchange Processes–A Review," *Journal of the American Water Works Association*, v. 64, no. 11, November 1972, p. 711.

(7) *Ibid.*

(8) *Ibid.*

(9) Crits, G. J.
"Some Characteristics of Major Types of Reverse Osmosis Modules," *Industrial Water Engineering*, v. 12, no. 6, December 1975/January 1976, p. 22.

(10) Doud, Donald H.
"Field Experience With Five Reverse Osmosis Plants," *Water and Sewage Works*, v. 123, no. 6, June 1976, p. 97.

(11) Mattson, Melvin E.
"Membrane Desalting Gets Big Push," *Water and Wastes Engineering*, v. 12, no. 4, April 1975, p. 40.

(12) Doud, D.H., *op. cit.*, p. 21.

(13) Cruver, James E.
"Reverse Osmosis–Where It Stands Today," *Water and Sewage Works*, v. 122, no. 10, October 1975, p. 75.

(14) Crits, G.J., *op. cit.*, p. 21.

(15) Cruver, J.E., *op. cit.*, p. 75.

(16) *Ibid.*, p. 76.

(17) Mattson, M.E., *op. cit.*, p. 38.

(18) Crits, G.J., *op. cit.*, p. 21.

(19) Askim, M.K. and C.M. Janacek, *op. cit.*, p. 76.

(20) Cruver, J.E., *op. cit.*, p. 76.

(21) Osmonics, Inc.
"Reverse Osmosis and Ultrafiltration Systems," Hopkins, Minnesota, Osmonics, Inc., Tech. Bulletin, no. G7606, KP40M.

(22) U.S. Environmental Protection Agency
"National Interim Primary Drinking Water Regulations," *Federal Register*, v. 40, no. 248, December 24, 1975, pp. 59570-59571.

(23) Doud, D.H., *op. cit.*, p. 97.

(24) *Ibid.*

(25) Cruver, J.E., *op. cit.*, p. 77.

(26) Miller, E.F.
"Demineralization of Brackish Municipal Water Supplies–Comparative Cost," *Journal of the American Water Works Association*, v. 69, no. 7, July 1977, p. 349.

(27) *Ibid.*

(28) Ionics, Incorporated.
"Aquamite XX," *Ionics*, Watertown, Massachusetts, Ionics, Incorporated, Product information bulletin, no. 103, June 1976.

(29) Lynch, M.A., Jr. and M.S. Mintz, *op. cit.*, p. 724.

(30) Ionics, Incorporated, *op. cit.*

(31) *Ibid.*

(32) Lynch, M.A., Jr. and M.S. Mintz, *op. cit.*, p. 724.

(33) Ionics, Incorporated, *op. cit.*

(34) *Ibid.*

(35) Miller, E.F., *op. cit.*, pp. 349-351.

(36) *Ibid.*

(37) Sierka, Raymond A.
"Membrane Processes in Water and Wastewater Treatment," Seminar Lecture at The University of Texas at Austin, Austin, Texas, November 3, 1977.

(38) American Society of Civil Engineers, American Water Works Association, and Conference of State Sanitary Engineers
Water Treatment Plant Design, New York, New York, American Water Works Association, 1969 (3rd ed.), p. 227.

(39) Holden, W.S., Editor
Water Treatment and Examination, Baltimore, Maryland: Williams and Wilkins Co., 1970, p. 394.

(40) *Ibid.*, p. 399.

(41) Gaffney, Jerome G., Robert Kunin, and Donald G. Downing
"Ion Exchange for Industrial Water," *Water Quality Improvements by Physical and Chemical Processes*, v. III, Austin, Texas: The University of Texas at Austin, Water Resources Symposium Number Three, Center for Research in Water Resources, 1970, p. 258.

(42) American Society of Civil Engineers, American Water Works Association, Conference of State Sanitary Engineers, *op. cit.*, pp. 228-230.

(43) Garrison, Walter E. and Robert P. Miele
"Current Trends in Water Reclamation Technology," *Journal of the American Water Works Association*, v. 69, no. 7, July 1977, pp. 365-367.

(44) Edwards, Stacy W.
"Special Water Treatment," *Manual of Water Utility Operations*, Austin, Texas: Texas Water Utilities Association, 1975, p. 253.

(45) Liptak, Bela G., Editor
"Ion Exchange Processes," *Environmental Engineers Handbook, V. I, Water Pollution*, Radnor, Pennsylvania: Chilton Book Co., 1974, pp. 1244-1245.

(46) Pfafflin, James R. and Edward N. Ziegler, Editors
"Water Treatment," *Encyclopedia of Environmental Science and Engineering*, v. 2, New York, New York: Gordon and Breach Science Publishers, 1976, p. 1060.

(47) Edwards, S.W., *op. cit.*, p. 252.

(48) LBJ School of Public Affairs Safe Drinking Water Policy Research Project, 1976-1977
Impact of the Federal Safe Drinking Water Act on Texas, Austin, Texas: Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin, 1978, p. 92.

(49) Culp, Gordon L. and Russell L. Culp
New Concepts in Water Purification, New York, New York: Van Nostrand Reinhold Co., 1974, p. 224.

(50) Sorg, T.J., *op. cit.*, p. 110.

(51) Fruh, E. Gus, Michael Humenick, and Myra Lansford
"Removal of Fluorides from Public Water Supplies," Austin, Texas: The University of Texas at Austin, Bureau of Engineering Research Report, 1976.

(52) *Ibid.*

(53) Sorg, T.J., *op. cit.*, p. 107.

(54) *Ibid.*, p. 110.

(55) Bernard Johnson, Inc., *op. cit.*

(56) Sorg, T.J., *op. cit.*, p. 107.

(57) Bernard Johnson, Inc., *op. cit.*

(58) *Ibid.*

(59) *Ibid.*

(60) Sorg, T.J., *op. cit.*, p. 107.

(61) Bernard Johnson, Inc., *op. cit.*

(62) Scheffer, Louis S.
"History of Desalting–Operations, Maintenance, and Cost Experience," *Journal of the American Water Works Association*, v. 64, no. 11, November 1972, pp. 726-727.

(63) *Ibid.*

(64) Askim, M.K. and C.M. Janecek, *op. cit.*, p. 78.

(65) *Ibid.*

(66) *Ibid.*

(67) Miller, E.F., *op. cit.*, p. 349.

(68) U.S. Environmental Protection Agency
Manual of Treatment Techniques for Meeting the Interim Primary Drinking Water Regulations, Cincinnati, Ohio: U.S. Environmental Protection Agency, May 1977, pp. 20, 28.

(69) Mattson, M.E., *op. cit.*, p. 42.

(70) Bernard Johnson, Inc., *op. cit.*

(71) Faber, Harry A. and Sidney A. Bressler
"Improving Community Water Supplies With Desalting Technology," *Journal of the American Water Works Association*, v. 64, no. 11, November 1972, pp. 723-725.

(72) Miller, E.F., *op. cit.*, pp. 349-351.

(73) Mattson, M.E., *op. cit.*, p. 40.

(74) Bernard Johnson, Inc., *op. cit.*

CHAPTER V
FINANCIAL ASSISTANCE FOR SAFE WATER

A Guide to Small Water Systems on Obtaining Aid

INTRODUCTION

The Safe Drinking Water Act, Public Law 93-523, directs public water systems to provide water that can meet federal standards. In order to remove water contaminants to achieve the standards, some communities may have to invest to build facilities to treat existing water or develop new supplies. The costs of drinking water will increase as a result due to such investments. Although the consumer can be expected to bear a share of the burden in increased water rates, some communities hope to obtain additional assistance from the federal, state, and regional levels of government.

This report describes the sources of assistance to communities to improve their drinking water supplies. It discusses eligibility requirements, application procedures, and decision criteria for technical aid, grants, and loans. Water system loans may be sufficient for some communities. Other communities may be unable to fully repay loans and thus require grants to sufficiently improve their water supplies. Communities may also seek technical assistance to prepare engineering designs, which often are prerequisites for grant and loan applications.

Table 5-1 summarizes the types of assistance available from the federal, state, and regional levels of government. Since Congress has not appropriated funds for the Environmental Protection Agency to aid communities in their attempts to comply with the Act, federal assistance will come principally from three other agencies. The Farmer's Home Administration can provide grants and loans for water projects in rural communities. The Economic Development Administration makes available grants and loans for water projects located within redevelopment areas. The Department of Housing and Urban Development can provide discretionary grants for water projects in urban communities.

SOURCES OF STATE ASSISTANCE

Financial assistance from the State of Texas for the construction of locally sponsored water projects is limited to loans from the Texas Water Development Board.* The regional Councils of Government and the Texas Department of Community Affairs can assist communities by advising them how to apply for available state and federal aid. The Texas Department of Health provides in-kind assistance to local water systems through surveillance and laboratory analysis of water systems.

*The Texas Water Development Board became part of the Texas Department of Water Resources under the Water Reorganization Act of 1977, assuming the chief policy and administrative role within the Department.

Texas Water Development Board

The Texas Water Development Board (TWDB) provides loans for the construction of locally sponsored water projects through the Texas Water Development Fund. The loans are provided by purchasing bonds issued by a community at a below-market rate of interest. The funds used to purchase community bonds are obtained from the sale of Texas Water Development Bonds, which are issued by the Board. The bonds and securities purchased by the Board bear the weighted average effective interest rate on all water development bonds previously sold, plus one half of one percent. Currently the effective interest rate is about 5.6 percent (1). The legislature has limited aid for any single water development project to $35 million, unless a majority of each house of the legislature adopts a concurrent resolution to extend additional loan funds (2).

The various programs administered by the TWDB amount to $600 million in bonds, of which $200 million is earmarked to enhance water quality through management of waste water. The remaining $400 million is for water development and may be used to finance the impoundment, transmission, treatment, or distribution of water. As of 1977, the TWDB has issued $250 million worth of bonds under the water development program. This leaves a residual of about $150 million in bonds that can be issued in the future.

The several constitutional amendments and the Texas Water Code prescribe the manner in which Texas can assist projects. These basic concepts of state assistance are listed in Table 5-2 (3).

Application Procedures

Loan applications begin with an interview with the manager of the Texas Water Development Fund. The manager determines whether the request is within the scope of the water development program. If the manager feels the case fits the TWDB criteria, the community is instructed to

TABLE 5-1: SOURCES OF ASSISTANCE TO SMALL PUBLIC WATER SYSTEMS IN TEXAS

Agency	Program	Type of Aid	FY 1977 Aid ($ millions)		FY 1977 Aid for Drinking Water Quality ($ millions)	Clients
Farmer's Home Administration	Rural Water and Waste Disposal Systems	loans	$31.46	(Texas)	not available	political subdivisions, private or public non-profit corporations
		grants	$17.347	(Texas)	not available	
Economic Development Administration	Public Works Facilities	grants	$26.822	(Southwest)	not available	associations representing an EDA-designated area or EDC, such as: —political subdivisions —Indian tribes —private or public non-profit corporations
	Supplemental 304 Projects	grants & loans	$ 0.694	Texas allocations	not available	
Department of Housing and Urban Development	Community Development	grants	$21.073	(Texas)	not available	SMSA or non-SMSA local governments
Environmental Protection Agency	Safe Drinking Water Act	loans	$ 0.0	(U.S.)	$0.0	public water systems
Texas Water Development Board	Water Development	loans & research	$19.339	(Texas)	$0.067 in research	political subdivisions
Texas Department of Health	Surveillance & Technical Assistance	laboratory	$ 4.300 (est.) in services	(Texas)	$4.2 (est.) in services	licensed water systems

complete a required written request for assistance to the Board. There are no standard application forms.

The written request should contain an expression of the community's needs, a description of the community's financial status, and a project design and feasibility study. In applying for a loan, applicants should bear in mind the criteria which the Board uses in evaluating applications. In passing on an application for loan funds, the Board must find that:

- the public interest requires state participation in the project;
- the political subdivision cannot reasonably finance the project without State assistance in the amount finally approved by the Board; and
- the revenue or taxes pledged by the political subdivision will be sufficient to meet all obligations during the period of the loan (4).

The size of the loan depends upon the size of the project and the financial status of the community. The limit of bonded indebtedness of a municipality for water conservation and development is 25 percent of the assessed property value (5). The Texas constitution does not limit the bonded indebtedness of a special district. However, as a general rule, the Board will not extend a loan to a special district for an amount greater than ten percent of the assessed value of real property (6). If a loan is approved, certain material and construction standards must be met. The agency will inspect the project during and after construction to assure compliance with those standards (7).

Potential for Support

During the fiscal year ending August 31, 1977, the TWDB loaned $19,339,000 to eight communities to aid local water projects (8). Those projects either provided general water system improvement funds for pumps, storage tanks, pipelines, etc., or enabled a system to increase the quantity of water it provides. Although the Board did not in fiscal year 1977 finance any projects specifically designed to improve the quality of drinking water, it could do so in the future.

A large community with a sound economic base is more likely to obtain aid than a small settlement. If a community cannot clearly demonstrate that it can repay a loan to finance treatment facilities to remove contaminants, it may not obtain support (9). The TWDB operates much like a banking institution and by statute cannot extend a loan unless it feels that the loan can be repaid.

Only certain water systems are eligible to apply to the TWDB. The Board can extend a loan only to political subdivisions in Texas, such as counties, municipalities, and special districts. All private water corporations, nonprofit or otherwise, are therefore excluded from TWDB assistance programs.

Texas Department of Community Affairs

The Texas Department of Community Affairs (TDCA) is a state agency that advises local governments on federal and state programs that may affect them. The TDCA also informs state officials and the public about the needs of local governments (10). The County and Rural Services

---

TABLE 5-2
PRINCIPLES OF TEXAS WATER DEVELOPMENT BOARD ASSISTANCE

It is the policy of the state to encourage the optimum development of the limited number of feasible sites available for the construction and enlargement of dams and reservoirs.

The cost of the facilities must exceed the current financing capabilities of the area involved, and local interest must be unable to reasonably finance the facilities without state participation.

The state legislature maintains through appropriations an experienced staff in the TWDB. This staff reviews project design and feasibility, and provides for inspection during and after construction.

All loans made to local political subdivisions must be repaid in full with interest at a rate equal to the weighted average effective interest rate on all water development bonds previously sold, plus one-half of one percent.

The program of state financial assistance is ultimately expected to be self-liquidating. However, in light of the Board's involvement in the acquisition of storage facilities in Texas reservoirs, this is not anticipated for a number of years.

Source: Texas Water Development Board, *The Texas Water Development Fund 1975 Annual Report*, Austin, Texas: Texas Water Development Board, August, 1975, p. 4.

Division of TDCA in the past has assisted small communities in improving water supplies. This division has aided communities in developing engineering and administrative plans for state and federal construction grant and/or loan applications. However, due to a recent cutback in appropriations from the Texas State Legislature, the TDCA has fired engineering staff and can no longer provide engineering services (11).

Councils of Government

Councils of Government (COGs) and regional planning commissions are associations of local units of government organized and governed by elected local officials to promote areawide cooperation, coordination, and planning. The COGs perform advisory and supporting functions for member local governments, although occasional staff support may be provided on request.

Federal grants and state and local government dues support the programs of the twenty-four COGs in Texas.* The regional councils may become involved in a wide variety of programs.** The COGs do administer the A-95 review, a federal coordination review and comment system. The A-95 review system examines local government grant applications to determine whether the proposed local project is consistent with regional plans or policies.

The COGs can assist local governmental units in identifying available sources of funding for water system improvement. In addition, regional councils can aid communities to complete applications for funding or educate officials of the community to do so. Some of the COGs, depending on their size and capabilities, have developed comprehensive studies on feasible water system sites in their areas. These studies can be used by local governments to estimate costs, determine soil conditions, or obtain desired information to improve their water systems.

Texas Department of Health

The Texas Department of Health (TDH) currently administers a public water supply supervision program through ten public health regions. A regional engineer conducts sanitary surveys of the various public drinking water systems in his or her jurisdiction and reports these findings to the central office for review. Central office staff in Austin review these sanitary survey reports and the plans and specifications for new water systems and water system improvements. To pass review, a plan must be prepared by a registered professional engineer and conform to all Texas Board of Health rules and regulations for public water systems. All plans must be reviewed and approved by the TDH prior to construction.

While a few cities do assess their own water for bacteriological contamination, most analyses are conducted by twenty-five regional TDH laboratories. All chemical and radiological analyses required for the Safe Drinking Water Act are performed by central office staff or in certified private laboratories.

The results of field surveys and monitoring analysis are continually added to TDH's files on each public drinking water supply. Each month TDH notifies any system that is out of compliance or fails to submit the required number of samples per month (12).

The TDH does provide technical assistance to local water suppliers in the form of annual sanitary surveys and follow-up inspections. These contacts inform a water supplier about the quality of the drinking water. Although TDH maintains an engineering staff to review proposed water system plans, this staff does not provide design or cost-estimation consultation (13).

It is estimated that the TDH provided local water systems with the equivalent of $4,300,000 in free testing services in 1977. Of that total, $1,300,000 went for chemical analyses and $3,000,000 for bacteriological analyses (14).

SOURCES OF FEDERAL ASSISTANCE

This section will assess the several federal programs that provide aid to communities for water supply improvements, as listed in Table 1. These agencies can be distinguished by their concerns for drinking water, community development, or water development. The U. S. Environmental Protection Agency regulates the safety of drinking water. This agency does provide limited technical assistance upon request to communities not in current compliance with the Act. The Economic Development Administration and the Department of Housing and Urban Development are in the business of community development. Both give grants and loans for infrastructural improvements. While either agency could finance water treatment or source development, safe drinking water is not a high priority with either. In addition, most of their aid is targeted at communities larger than those Texas towns with fluoride or nitrate problems. The Farmer's Home Administration views water system development as its business. This federal agency provides grants and loans for construction of rural water supply systems.

The Environmental Protection Agency

Congress, through the Safe Drinking Water Act, authorized the Environmental Protection Agency (EPA) to establish national drinking water standards and directed the

---

*Figure A-1 is a map of the locations of the twenty-four Texas COGs. List A-1 contains the administrative addresses of the COGs.

**These programs may include comprehensive planning; assisting local governments in carrying out regional plans or recommendations; providing certain services such as training or technical assistance; planning for manpower programs; criminal justice planning and action programs; and rural development.

states to assume primary responsibility for implementation and enforcement of those standards (15). Congress did appropriate funds through EPA to aid states in administering the Act. However, Congress has not appropriated funds through the EPA to assist communities to comply with the Act. Indeed, the EPA has inferred that Congress intended compliance costs to be born by the local water consumers through increased rates (16).

It is uncertain whether financial aid will become available through EPA in the future. On the one hand, a staff member of the Senate committee responsible for drinking water policy explicitly denied rumors that any new EPA grant program was under development or consideration (17). On the other hand, Public Law 95-188, "The Safe Drinking Water Amendments of 1977," did authorize $8 million to assist states or publicly owned water systems during drinking water emergencies if those governments are unable to remedy the emergency (18). Other provisions of P.L. 95-188 show more promise to financially aid small systems. One amendment directs the EPA to conduct an annual survey of rural water supplies in fiscal year 1978 and 1979. It instructs the EPA Administrator to submit to Congress an analysis of alternative methods of compliance; the relative cost of such methods to large, medium, and small systems; and alternative ways of financing compliance. Given this study, Congress will be in a better position to determine how much federal assistance is needed and how it should be administered (19). The report is due eighteen months after the date of enactment. If the report leads to the passage of amendments allowing construction grants or loans, those funds would be available from EPA no sooner than 1980 (20).

Farmer's Home Administration

The Farmer's Home Administration (FmHA) is an agency within the U.S. Department of Agriculture that provides credit for rural communities that are unable to obtain credit from other sources at reasonable terms and rates. Both loans and grants are available to aid in water system development under the Consolidated Farm and Rural Development Act of 1926 and Title V of the Housing Act of 1949.

The agency has state, district, and county representatives. There are eleven district offices in Texas* and the central state office is located in Temple. Loans are made through 145 Texas county FmHA offices. Several types of guaranteed/insured loans are available from FmHA, including youth project loans, emergency loans, farm ownership loans, rural housing loans, and community facilities loans. To obtain financing to improve a water system, a community should apply for a Community Facilities Loan. Grants for up to 50 percent of project development costs are also available under this program if sufficient need can be demonstrated.

The FmHA is authorized to make loans to develop community facilities for public use in rural areas and towns of up to 10,000 people. Loans are available to municipalities, counties, and other political subdivisions, as well as nonprofit corporations. Funds may pay for the construction, repair, enlargement, or improvement of water systems, including distribution lines, wells, pumping facilities, and other related costs. Only those communities not eligible for credit from commercial or cooperative sources are eligible for FmHA aid. In addition, each applicant must have the legal authority necessary "for constructing, operating, and maintaining the proposed facility or service and for the obtaining, giving security for, and repaying the proposed loan" (21). The applicant must demonstrate the financial capacity to retire the debt and to pay for the operation and maintenance of the water system from appropriate sources of local funding. Applications must be consistent with the development plans of the area (Council of Government's A-95 review) and comply with federal, state, and local laws. An environmental impact assessment is required of all applicants. The term of the loan cannot exceed forty years or the useful life of the facility to be financed, whichever is less. The size of the loan cannot exceed any statutory limitation on borrowing authority. The interest rate is currently 5 percent on the unpaid principal. Technical assistance is available to the applicant to develop a proposal, which should include discussions on engineering feasibility, economic soundness, cost estimates, organization, financing, and management matters in connection with the proposed improvements.

The FmHA may authorize grants in addition to loans, for amounts up to 50 percent of project development costs for water and sewage disposal systems. Grants are limited to projects serving the poorest communities in order to reduce user costs to a reasonable level (22). Reasonable user rates are defined as rates which are not less than existing prevailing rates in communities being served by an established system constructed at similar costs having similar economic conditions (23). A grant will be considered to reduce the financial burden if debt service for a water system exceeds one percent of the average or median income of the area. Grant funds may be used to install or improve a water system; this includes facilities for the development, storage, treatment, and purification of water (24). In addition, the funds may be used for acquiring land and rights (water rights, leases, permits, etc.), buildings, fences, or secondary facilities. Relocation, engineering services, and legal fees are also acceptable for reimbursement.

Application Procedures

The application process for a loan or grant begins with a conference between the applicant and the FmHA representative. If the project meets the requirements of financial assistance, the applicant files form AD-621, "Pre-Applica-

*List A-2 provides addresses of FmHA district offices in Texas.

tion for Federal Assistance," with the designated FmHA County Supervisor. A written notice of intent must also be filed with the appropriate Council of Government (COG) for A-95 review and priority recommendations. The County Supervisor sends the preapplication form (AD-621), along with the COG's clearinghouse comments and form FmHA 440-46, "Environmental Impact Assessment," to the State Director for review. The State Director determines whether or not the applicant should be able to finance the project from bond sales on the open market or can obtain credit elsewhere at reasonable rates and terms. The State Director also judges whether the applicant is "financially competent," i.e., able to repay the loan. The State Director is the loan approval official for all projects in the state.

Federal regulations require that the State Director state the results of the review on form AD-622, "Notice of Pre-Application Review Action" within forty-five days from receipt of application. This notice is sent to the County Supervisor, who informs the applicant of the results. If the loan request is not granted, the State Director must cite specific reasons for turning down the loan. An applicant can request administrative review of a decision or can resubmit the application if funding cannot be obtained from other sources.

If the project is approved, the State Director assigns a Community Program Specialist to assist the applicant and County Supervisor with assembly and processing of the application docket. The application docket involves filling out form AD-624, "Application for Federal Assistance," and related documentation. Usually the County Supervisor arranges a conference to provide applicants and their professional technical representatives with the documents necessary to complete the application. A checklist of the necessary documents needed to complete the application is often provided.*

The water system is required to maintain records and accounts which reflect the operation of the facility and its financial affairs. The FmHA requires that loan recipients provide the agency copies of biennial audits. In addition, FmHA requires access to all documents relating to the operation of the facility.

Funding Priorities

FmHA's loaned $31,476,000 to aid water and waste water disposal system projects in Texas in 1977. The FmHA's granted $17,347,000 to Texas communities in 1977. Priority for funding under the Community Facilities Loan Program is given to rural communities of less than 5,500 persons with inadequate water systems. Federal regulations require the FmHA to give due consideration to improvements required for compliance with the Safe Drinking Water Act (25). However no monies have been targeted to aid water systems with water supplies that do not meet federal maximum contaminant levels.

*List A-3 contains a sample checklist of loan or grant application documents.

Economic Development Administration

The Economic Development Administration (EDA) is an agency within the Department of Commerce. The EDA was created by the Public Works and Development Act of 1965 to provide opportunities for employment in economically distressed areas of the country. It administers economic development programs that include public works, public service, and development facility projects. In addition, EDA was mandated by the 1972 Amendments to the Public Works and Development Act to administer grants for short-term projects which provide immediate and useful work to the unemployed and underemployed in the designated redevelopment area.

The EDA has a central office in Washington, D.C. and six regional offices across the country to "cooperate with and assist the local areas in organizing for economic development" (26). The appropriate Regional Office reviews the applications in its region and submits a recommendation for action. The Assistant Secretary for Economic Development, Department of Commerce, has final approval disapproval of all loan and grant applications.

The Southwestern Regional Office in Austin, Texas serves Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. In addition, three Economic Development Representatives are located in Lubbock, Laredo, and Austin. These representatives disseminate information to the public about EDA programs and activities.** The representatives can also provide guidance to potential aid applicants (27).

Eligibility for Aid

In order to be eligible for any type of EDA assistance, a project must be located within an EDA-designated Redevelopment Area or designated Economic Development Center.*** If these criteria are met, the eligible area must develop an Overall Economic Development Program in order to qualify for EDA assistance. This Program is developed by the authorized district "to assist in alleviating the economic distress, unemployment, and underemployment that has restricted its economic growth" (28).

An Economic Development District (EDD) contains one or more redevelopment areas or economic development centers and is of sufficient size and population "to foster economic growth and alleviate the distress of the redeveloped areas within the district" (29). Some EDDs are established to follow the boundary lines of regional

**List A-4 shows the addresses of EDA offices in Texas.

***List A-5 contains the criteria for EDA Redevelopment Area designation. Figure A-2 is a map of Redevelopment Areas in Texas.

planning commissions. There are twelve multicounty EDDs and twenty-four Councils of Government in Texas that receive support from the EDA.

Designation of an EDD calls for the simultaneous designation of at least one Economic Development Center. A Center generally coincides with the boundary lines of a city or grouping of continguous incorporated places within the Economic Development District. A Center's population cannot exceed 250,000. The Center must also have locational or economic ties to an EDD, so that its economic growth can help alleviate the overall distress of the district.

Once eligibility has been determined, a community in a designated area may receive financial assistance for the improvement of water systems under several EDA programs. Grants and loans for Public Works and Development Facilities are available to assist in the construction of public facilities needed to stimulate long-term economic growth. Grants are available for Public Works Impact Projects. These projects involve the construction of public facilities which provide immediate work to the unemployed in the area. Grants may also be made to states for Supplemental and Basic Assistance under Section 304 of the Act. These programs are described in the following sections.

Public Works and Development Facilities

States or political subdivisions, Indian tribes, private/public nonprofit organizations, or associations representing an EDA-designated Area or Center are eligible to apply for funds. Financial aid may be used to acquire or develop land, and to purchase, construct, rehabilitate, alter, expand or improve public works, public service, or development facilities. Eligible projects include municipal water and sewer facilities.

Project applicants must demonstrate that the project will have a positive, long-term impact on the economic growth of the area. In addition, proposed projects must be consistent with the Overall Economic Development Plan for the Area or District in which they are located.

The EDA can make either grants or loans. EDA may make direct grants of up to 50 percent of total eligible costs. If the area is severely depressed, the EDA may grant supplemental funds to an amount equal to 80 percent of the project's total costs. EDA may also provide long-term low-interest loans. The application process is described below in the "Application Procedures" section.

Public Works Impact Projects

In 1971, Congress passed an amendment to the Public Works and Development Act that authorizes funds to support immediately useful work to the unemployed and underemployed through short-term construction of public facilities. These projects must be in areas with (a) a large concentration of low income persons; (b) rural areas having substantial outmigration and substantial unemployment; or (c) areas with an actual or threatened abrupt rise of unemployment due to the closing or curtailment of a major source of employment (30).

Grants can pay for up to 80 percent of the costs of a Public Works Impact Project. Projects are not required to be related to the Overall Economic Development Program of an area. The application and process for the Public Works Impact Program is identical to the Public Works and Development Facilities program. Priority is given to projects requesting less than $600,000.

Grant and Loan Supplements

Under Section 304 of the Public Works and Development Act of 1965 as amended in 1974, funds are apportioned among the states to supplement any EDA grant or loan authorized under Titles I, II, III, IV, and IX of the Act. The governors select eligible EDA projects which will enhance the economic growth of an area. These projects must be consistent with the Overall Economic Development Program of the area and the district, if any, in which it will be located. The state must make a contribution equal to a least 25 percent of the supplemental federal funds. The grants or loans may be used to construct water, access roads, or other public facilities. The application is processed in a manner identical with the other EDA programs.

Application Procedures

The EDA representative meets with the community leaders to determine the viability of the proposal. After reviewing specific information on the project and the community, the EDA representative notifies the applicant of the results. If the applicant is eligible, a preapplication conference is arranged by the Regional Office. In addition, the eligible applicant must submit the project proposal to A-95 review of the appropriate COG. An environmental assessment is also required.

At the preapplication conference, the EDA representative provides the community with the required forms, explains the application process, and answers any questions. When the application is complete, the proposal is submitted to the Regional Office for review and comment. The Regional Office reviews the project proposal, taking into account its budget and impact.

An analysis of the applicant's file is then sent, with a recommendation for approval/disapproval, to the Assistant Secretary for Economic Development in Washington, D.C. for final action. Generally, the applicant is notified of the results within a ninety-day period. If financial assistance is granted, the recipient community is required to keep reports and records necessary for facilitating required EDA audits.

Funding Priorities

The EDA is a possible source of funding for communi-

ties that can qualify. The Southwestern Regional Office provided $26,831,865 in 1977 for Public Works Facilities grants. Texas' allocation for supplemental 304-Projects in 1977 was $693,810 (31). The EDA has granted funds to assist water system development in Texas. In 1976, the agency contributed $168,407 to Lincoln Park in McLennan County for the purpose of extending a public water system. This grant, under the "Supplemental Funds" section, was matched by a Texas contribution of $22,805.

The prospects are uncertain for funding of water improvements associated with the Safe Drinking Water Act. According to an EDA representative, any "water system improvement must compete for funds with all other projects. No special priority is given to applicants with water systems out of compliance with the Safe Drinking Water Act" (32).

Department of Housing and Urban Development

The Department of Housing and Urban Development (HUD) was created in 1965 to administer housing programs and to provide coordination of the various federal activities which affect urban, suburban, or metropolitan development. The Community Development Block Grant Program was established in 1974 to develop viable urban communities through the provision of decent housing, a suitable living environment, and expanding economic opportunities for persons of low and moderate income. HUD headquarters are in Washington, D.C. and field operations of the Department are carried in regional and area offices. Within Region VI (composed of New Mexico, Oklahoma, Arkansas, Louisiana, and Texas) there are Area Offices located in Little Rock, New Orleans, Oklahoma City, Dallas, and San Antonio. Area Offices are responsible for administering HUD programs under their assigned jurisdictions.*

Grant assistance is provided for entitlement and discretionary recipients. Entitlement recipients are (a) communities of more than 50,000 persons in urban counties, defined as Standard Metropolitan Statistical Areas (SMSAs) and (b) cities with fewer than 50,000 persons which are central cities in SMSAs. These recipients receive funds based on a formula for a three-year period. Entitlement grants are to be directed toward problems of poverty and overcrowded housing in urban communities. Funds may be used to acquire or construct certain public work facilities or improve and rehabilitate housing. Presently, there are seventy-six entitlement communities in Texas.**

Discretionary recipients compete annually for a fixed amount of funds. The financial aid is intended to develop viable urban communities and expand economic opportunities for the poor. Although funds are often directed to housing rehabilitation, on occasion they may be added to other federal monies for joint project financing. Applicants may be eligible for grants from any of three discretionary funds. "General Purpose Funds," those funds remaining after entitlement obligations are met, are generally directed toward those communities ineligible for entitlement funding. "Urgent Needs Funds" are monies for urgent community development needs. "Secretary's Funds" are composed of two percent of total funds that are set aside each year for specified projects, such as innovative community development.

Application Procedures

Preapplication submission dates are established by the HUD Secretary each fiscal year for each of the three discretionary funds. If a community wishes to apply, it contacts its Community Development Representative in the district for technical assistance in preparing an application. Both an environmental impact statement and a COG review and comment (A-95 review) are necessary.

For the "Secretary's Fund" and "Urgent Needs Fund", the applicant files the basic entitlement application with specified modifications. For the "General Purpose Fund" a preapplication is rated against other projects based upon the number of affected persons of low and moderate income and specified eligible activities.*** The Dallas Area Office requests a full application for approximately one out of seven of the preapplications for General Purpose Funds (32). When a preapplication is approved, the community then completes applications forms. Generally, the Area Office notifies the applicant of approval/disapproval within seventy-five days. There are no appeals. If a project is approved, the community will be required to comply with the HUD system of financial reports and annual audits.

Funding Priorities

Competition for funds is great and HUD awards funds through a complicated formula related to the impact upon low- or moderate-income persons. Housing and neighborhood development are considered to be priority targets and most awards go to housing rehabilitation. An exception was a discretionary grant of $100,000 in 1976 to Waco and Bellmead, Texas. This grant financed an extension of the public water system to all persons in Lincoln Park, an incorporated area in McLeannan County between Bellmead and Waco. The purpose of this project was to remove the health hazards of E. Coli bacteria in drinking water (34). HUD spent $21,073,000 in Texas under the Discretionary

*HUD office addresses in Texas are shown in List A-6.

**Only seventy-three Texas communities received funding under this program in 1977. Richardson and Irving did not apply for their entitlement funds and Midland did not comply with the required provision for a Housing Assistance Plan.

***List A-7 presents thirteen activities eligible for Block Grant assistance.

Program. Communities should view HUD as a possible source of financing for water system projects.

CONCLUSIONS

This report has described the sources of assistance to communities to improve their water supplies. Financial aid from the State of Texas for construction of locally sponsored water projects is limited to loans from the Texas Water Development Board. Only political subdivisions are eligible. Because the major prerequisite for loans is the ability to repay the loans, some poor rural communities may be excluded from financial assistance. Private water corporations, whether profit or nonprofit, are not eligible for TWDB assistance. The Texas Department of Health conducts the chemical and radiological analyses required for the Safe Drinking Water Act as part of its public health mandate. Water systems are notified if out of compliance with the federal maximum contaminant levels. However, no monies for local projects are available from this agency.

On the federal level, the Environmental Protection Agency establishes national drinking water standards and financially aids the states in administering the Act. No funds have been appropriated through the EPA to assist local communities. Rather, the EPA has adopted a policy that local water consumers should bear the compliance costs through increased rates. The Farmer's Home Administration has both loan and grant programs available to aid in water system improvement for political subdivisions and not-for-profit private water associations. The FmHA is committed to rural community projects and has allocated relatively large amounts of financial aid to water system projects. Thus, the FmHA is an excellent source of financial assistance for Texas communities to improve their drinking water supplies. FmHA loans also carry a lower interest rate than those from the Texas Water Development Board. The Economic Development Administration and the Department of Housing and Urban Development have financial aid programs which may be used for water system improvement. However, eligibility is restricted for these programs and priority is given to projects other than water supply improvement.

It is possible for a local community to get joint funding from a combination of the above agencies. The TWDB has in the past loaned a community the monies necessary to meet EDA grant matching requirements. An example of joint funding is Lometa, Texas, which in 1977 secured $100,000 from HUD, $275,000 from FmHA, and $175,000 from TWDB in addition to raising $10,000 through general obligation bonds.

In conclusion, local communities have several potential sources of financial aid for water system improvement. The FmHA is the most probable source of aid. Agency representatives have not been optimistic regarding the outlook for new sources of funds or significant increases in the level of local aid from existing sources. For most local water systems, increased water rates are likely to be the major source of revenue for improvements related to the Safe Drinking Water Act.

REFERENCES

(1) Holcomb, Charles
Interview by Larry Junek at the Texas Department of Water Resources in Austin, Texas, on January 27, 1978.

(2) Texas Water Development Board
The Texas Water Development Fund 1975 Annual Report, Austin, Texas: Texas Water Development Board, 1975, p. 4.

(3) *Ibid.*, p. 3.

(4) Anon.
Texas Water Code, Section 11.405, in *Vernon's Texas Codes Annotated*, St. Paul, Minn.: West Publishing Co., 1972, p. 252.

(5) *The Constitution of the State of Texas*, Art. III, Sec. 52.

(6) Ivey, W.L.
Interview by Larry Junek at the Texas Department of Water Resources in Austin, Texas in September 1977.

(7) *Ibid.*

(8) Texas Water Development Board
Annual Financial Report, Austin, Texas: Texas Water Development Board, 1977.

(9) Holcomb, C., *op. cit.*

(10) Texas Department of Community Affairs
Community Development Catalog (second edition), Austin, Texas: Texas Department of Community Affairs, 1976.

(11) Williams, Larry
Interview by Larry Junek at the Texas Department of Community Affairs in Austin, Texas on October 4, 1977.

(12) Texas Department of Health
"State of Texas FY 78 Public Water Systems Supervision Program Grant Application," Austin, Texas: Texas Department of Health (mimeo), August 25, 1977.

(13) Texas Department of Health
Rules and Regulations for Public Water Systems, Austin, Texas: Texas Department of Health, 1975.

(14) Williams, Floyd
Telephone interview by Larry Junek, Texas Department of Health in Austin, Texas in April 1978.

(15) *U.S. Code–Congressional and Administative News,* no. 11A, Public Law 95-188, St. Paul, Minnesota: West Publishing Company, 1977, p. 7.

(16) Costle, Douglas M.
Congressional Record, July 12, 1977, p. 6858.

(17) Cummings, Philip T.
Presentation at National Conference on Drinking Water Policy Problems in Washington, D.C., March 6-8, 1978.

(18) U.S. *Code–Congressional and Administrative News,* op. cit.

(19) *Congressional Record,* July 12, 1977, p. 6857.

(20) Jeffrey, Edgar A.
Interview by Aileen C. Whitfill and Larry Junek at the EPA Regional Office in Dallas, Texas on October 4, 1977.

(21) Farmer's Home Administration
"Community Facility Loans," *Federal Register* vol. 42, no. 93, Section 1933.17(2)(iii), May 1977, p. 27233.

(22) Farmer's Home Administration
"Development Grants for Community Domestic Water and Waste Disposal Systems," *Code of Federal Regulations* 7, Section 1823.472(b).

(23) *Ibid.*

(24) *Ibid.*, Section 1823.472(c)(1).

(25) Farmer's Home Administration, *Federal Register, op. cit.*, Section 1933.17(a)(vii).

(26) Economic Development Administration
"Description of Organization," *Code of Federal Regulations 13,* Section 301.42(b)(10).

(27) *Ibid.*

(28) Economic Development Administration
Guide for Economic Development Program, Washington, D.C.: Department of Commerce, February 1976, p. 2.

(29) Farmer's Home Administration, *Code of Federal Regulations 13, op. cit.*, Section 302(c).

(30) *Ibid.*, Section 302.7.

(31) Miller, Jan
Interview by Aileen C. Whitfill at Economic Development Administration in Austin, Texas on October 4, 1977.

(32) *Ibid.*

(33) Garrett, Leo
Interview by Aileen C. Whitfill at Department of Housing and Urban Development in Dallas, Texas on October 25, 1977.

(34) *Ibid.*

CHAPTER VI

A GUIDE TO COOPERATIVE SERVICE ARRANGEMENTS FOR COMMUNITY WATER SYSTEMS

Texans have long recognized the fundamental tension between community prerogatives to use and enjoy local water and the public's right to a dependable, safe source of drinking water. To balance these rights, the state has responded with an extensive body of water law. Common law concepts regulating water use date from the period of Spanish control. The first state water legislation was enacted in 1899. Although Texas' first State Sanitary Engineer, Victor H. Ehlers, became involved with water supplies in 1915, formal state supervision and regulation of drinking water supply did not begin until 1945 with passage of the Texas Sanitation and Health Protection Law. The law vested the Texas Department of Health with regulatory responsibility for maintaining the quality of potable water. In 1977, the agency was designated to carry out the provisions of the Federal Safe Drinking Water Act, Public Law 93-523 (the Act).

Despite evolving state and federal water policy, water supply remains a local service. In Texas, there are over four thousand water supply systems including municipalities, special water districts, water supply corporations, and mobile home parks (1). One consequence of the local responsibility for water supply is that some small suppliers are out of compliance with the federal drinking water standards, and apparently do not have the resources to meet those standards. Of about 550 community water suppliers with drinking water that exceeds at least one of the maximum contaminant levels specified in the federal regulations, 191 systems serve fewer than 100 persons. Another 177 of these water utilities serve 100 to 500 persons (2). Some of the small public and private water conveyors possess neither the will, nor the money, nor the skilled manpower to install or maintain treatment equipment to improve water supplies to meet the maximum contaminant level (3). The State of Texas is not likely to allow permanent variances or exemptions to all these noncompliant systems. How will such systems respond when they are required to supply water to meet standards but believe they are unable to do so?

Cooperative water service arrangements provide an attractive solution for some systems. Through cooperation many small suppliers can gain sufficient financial and administrative resources to comply with the Act. When it becomes necessary to install water treatment equipment or develop alternate water sources, cooperating water systems may benefit from the advantages of engineering economies of scale and a larger pool of consumers.

The purpose of this paper is to analyze the financial, legal, organizational, and political ramifications of cooperative service arrangements. It is tailored to meet the information needs of those most likely to be interested in cooperative water supply development: waterworks officials, water lawyers, consultants, and elected officials. This guide is organized into five sections. Section one provides an overview of the laws and government institutions that impact the operations of a water supply system in Texas. Within this legal framework, sections two and three examine water supply institutions which may be viewed as alternatives to an existing arrangement. Section four discusses methods for financing cooperative water supply development. The final section suggests several approaches to deal with the political implications of implementing a new water supply arrangement.

TEXAS WATER POLICY

Basic responsibility for managing water resources in Texas resides with the state. Under certain circumstances, the state has ceded a limited role for drinking water regulation to substate authorities. The purpose of this section is to describe the basic elements of Texas water law, the institutions responsible for water resource enforcement and management, and the position of the local water supply system within this legal framework.

Regulation of Water in Texas

The creation and operations of any local water supply system are subject to regulation by federal, state, and local governments. The major agencies are described briefly to establish the regulatory framework.

The Safe Drinking Water Act assigns the legal responsibility for enforcing federal drinking water standards to the U.S. Environmental Protection Agency (EPA). The Act directs the EPA to establish drinking water quality criteria for all public water supply systems having at least fifteen

service connections or regularly serving at least twenty-five people. The EPA has issued interim primary standards establishing maximum allowable levels for bacterial, chemical, and radiation contaminants in drinking water. Responsibility for the enforcement of these standards lies with the EPA, unless the state petitions to act as designee.

In Texas the State has accepted a leading role in the administration of drinking water standards. These functions are performed by the Texas Department of Health (TDH) (4) and the Texas Public Utility Commission (TPUC) (5).

TDH is charged by statute with responsibility for the protection of the health of the citizens of the state. Within the area of environmental health, the agency's responsibilities include (a) water monitoring and analysis, (b) enforcement of health and safety standards, and (c) approval of plans and specifications for the construction of public drinking water systems. The Governor has also designated TDH to enforce the drinking water quality standards and assure water system compliance with the Act.

TPUC regulates public and private water utility operations in the state. Before a water supply system commences operations, it must secure a Certificate of Convenience and Public Necessity from the TPUC. The certificate represents an administrative authorization to operate the water utility. Each applicant is required to show that the proposed service is required by public convenience and necessity, and that it is "fit, willing and able" to perform properly the proposed service and to conform to all relevant regulations. In addition, TPUC directly regulates the rates, operations, and services of nonmunicipal water systems in nonmetropolitan areas. Municipalities may transfer their regulatory powers pertaining to water services to the TPUC if they desire to do so.

Texas counties have not played an active role in drinking water regulation and administration. Nonetheless, Texas statutes do provide avenues for county involvement, particularly with regard to water districts. Certain water districts authorized by general law may be created by county commissioners' courts. In addition, water districts often must meet statutory requirements for financial and organizational registration with the county government. The State of Texas has delegated the responsibility for maintaining an adequate and safe water supply to incorporated municipalities. They may adopt health standards and regulate water rates of water supply systems operating both inside and outside of their municipal limits.

Use of Water in Texas

These federal, state, county, and local agencies collectively manage water resources that may belong to persons, businesses, or government agencies. The state has the constitutional right to regulate all surface waters and groundwaters within its legal boundaries. However, in practice, the state has chosen to regulate only certain categories of surface water, and only recently has begun to control groundwater.

Texas law recognizes two categories of surface water, "diffused water" and "water within a defined watercourse." Diffused surface water is surface drainage over the face of a tract of land which is not yet concentrated into a channel or watercourse (6). In Texas, private landowners are not restricted in the use of diffused surface water which is located on their land. Once diffused surface water enters a watercourse, however, it becomes the property of the state and subject to state regulation. A watercourse is defined as an identifiable natural stream having a definite channel originating from a defineable source of water (7).

The right to use surface water, initially established by Spanish land grants, has since been girded by the application of both the "riparian" and "appropriation" doctrines. Under the riparian doctrine, any individual or institution obtains a common law right to draw surface water by owning land that abuts a watercourse. This common law right has been modified by statute and is no longer fully operative (8). Only users who filed recognized claims with the Texas Water Rights Commission (now called the Texas Water Commission) prior to September 1974 are vested with such riparian water rights. Those who did not file claims can acquire the right to take surface water by obtaining a water permit.

The Texas Water Commission is charged by statute with the administration of appropriation rights to Texas water resources (9). Any person or institution interested in appropriating surface water much apply to the Commission for a permit. An application is considered if it is in proper form, complies with statutory provisions, contemplates an authorized use of water, does not impair existing water rights, and is not detrimental to the public welfare (10). Pending approval of the application, the Commission can issue a permit to take and use water. Restrictions may be placed on the permit holder as to the type, duration, or season of water use. The holder perfects an appropriation right for the duration of the permit by making beneficial use of the water. However, a permit may be formally cancelled prior to expiration as a result of decision based on administrative hearings or judicial proceedings.

The term groundwater is used to describe waters which ooze and percolate through undefiniable channels in the earth's crust. In Texas, landowners possess a common law right to take all the water that can be captured from beneath their land. Water which flows beneath and alongside of a surface stream channel is considered surface water and is thus the property of the state (11).

WATER SUPPLY ARRANGEMENTS

There are more than four thousand water supply systems in Texas operating under a variety of legal charters. The populations served by these systems range from less than twenty-five persons to more than one million. The basic institutional forms of water supply systems serving Texans include municipal water systems, water districts, river authorities, private profit-making water systems, and nonprofit water supply corporations. The State of Texas delegates to incorporated communities the responsibility to provide an adequate water supply to their residents and the authority to own and operate a water system. Unincorporated communities, which typically have fewer than two hundred residents, do not have the authority to own or operate a water system. The residents of these jurisdictions either use individual wells or form providers such as water districts, nonprofit water supply corporations, or private profit-making systems.

These basic institutional entities are distinguished by different administrative structures and legal requirements. This section describes their legal and institutional characteristics.

Municipal Water Systems

When the population of a community reaches two hundred persons the voters may decide to incorporate the jurisdiction. A "general law city"–an incorporated community which ordinarily has fewer than five thousand residents–may construct, own, and operate a water supply system. The creation of a municipal water system requires the approval of the local governing body. Cities having a population of more than five thousand may accept the full powers of local governance through the enactment of a home rule charter. The charter, which establishes the powers that may be exercised by the city, must be approved by a majority of the voters residing in the community. The home rule charter may direct, restrict, or prohibit the city from operating a facility to provide water service. With proper charter authorization, the local governing body may authorize the creation of a municipal water system.

Incorporated towns and cities are provided by state statute with the right of eminent domain to condemn property, to construct water mains, supply reservoirs or standpipes for waterworks, and to drill water wells within or outside the corporate limits (12). Any town or city which owns or operates a water utility can (a) own land for such purposes, and (b) purchase, construct, operate, and regulate water systems within or outside the corporate limits (13). The incorporated jurisdictions may issue bonds to finance the construction of the water supply facility. These powers are subject to any restrictions imposed by home rule charter provisions and local ordinances.

The primary function of a municipal water supply system is to furnish water to the community's residents. A municipality may choose to assign administrative responsibility for the provision of other services, such as sewage disposal, to the same entity.

As a municipal water system is owned and operated by the community, it is controlled by and directly accountable to the citizens' elected representatives. Moreover, the water rates are often set by the local legislative body. These characteristics suggest a high level of political involvement from both the voters and local officials. Even if a municipal water system is too small to take advantage of economies of scale to facilitate compliance with federal standards, it often has the flexibility to pursue cooperative arrangements.

Water Districts

Water districts are special units of local government which provide water-related services within recognized geographic boundaries. These special-purpose districts have limited powers and are autonomous governmental entities, independent of cities and counties. The size of the service area may vary from a few acres to several counties.

Water districts may be created under general or special laws. At present, Texas statutes permit the formation of eight types of general law districts.* The general statutory procedure for the creation of a general law district commences with a petition for the establishment of a district signed by a certain percentage of taxpaying residents. A hearing is then held by the Texas Water Commission, or a county commissioner's court, to determine the merits of the petitioners' request. If the petition is approved, confirmation elections are held to determine voter support. After voter approval, directors are appointed or elected to govern the district.

A water district may also be created by the Texas Legislature. It is empowered to create a district by passing a special law which provides the name, powers, governing board and jurisdictional authority of the district. The law may provide for a vote to confirm the legislative act.

The Texas Constitution establishes water districts as institutions to control, store, preserve, and distribute waters from storms, floods, rivers, and streams for purposes such as navigation, power, drainage, and domestic consumption

---

*Water Control and Improvement Districts, Underground Water Control Districts, Fresh Water Supply Districts, Municipal Utility Districts, Water Improvement Districts, Drainage Districts, Levee Improvement Districts, and Navigation Districts.

(14). This broad constitutional mandate has resulted in the creation of hundreds of districts with varying functions.

The functions of the eight types of "general law" water districts are established by the respective enabling statutes. As noted in Table 6-1, the power to supply and conserve water is commonly provided to districts although statutes may allow other roles. The municipal utility district provides organizers with maximum functional flexibility. "Special act" districts are not easily examined; the hundreds of separate acts vest districts with varying responsibilities.

As governmental service entities, water districts possess only those limited powers necessary to supply water to their jurisdictions. A water district cannot promote the health and general welfare in a manner comparable to an incorporated community. However, a district's authority does include rights to (a) take private land for the public good (eminent domain), (b) levy taxes and special assessments, and (c) issue bonds, subject to the limitations provided in the enabling statutes.

The transfer of the municipal water supply function to a water district is usually viewed as permanent, although there may be legal opportunities for recall. The perceived permanency of the arrangement, the high degree of administrative and fiscal autonomy, and the resulting restriction of local autonomy may prompt voter opposition. Yet the water district strategy remains an attractive organizational alternative. The water district may cross existing political subdivisions to serve an area of several communities.

River Authorities

River authorities are autonomous regional governmental entities established by the state to manage water resources in major Texas river basins. Since most major Texas rivers flow wholly within Texas, the state has been able unilaterally to establish river authorities. As a result, all major rivers in Texas are served by one or more river authorities.

Though the Texas Constitution does not specifically authorize the creation of "river authorities", it provides for the creation of conservation and reclamation districts to manage Texas' water resources. It is under this authority that the Texas Legislature has, by individual special act, created twenty-four regional entities which may be classified as river authorities (15). One additional authority, the Red Bluff Water Power District, has been created by administrative action of the Texas Water Commission.

River authorities usually are concerned with water conservation, water supply, and waste water treatment. A number of river authorities also plan for flood control or recreational development, or assume other functions, as listed in Table 6-2.

The State Legislature has restricted the debt limit of some river authorities by statute. It has given nine river authorities the power to levy ad valorem taxes and issue general obligation bonds. All river authorities may issue bonds secured by future revenues. General obligation bonds may be issued only after approval by the voters of the jurisdiction.

The creation of a river authority is generally viewed as a permanent measure. Basinwide support from local officials and the general electorate is a likely prerequisite for a special act to pass the Legislature. Voter ratification may or may not be stipulated in the act.

Private Profit-Making Water Systems

Private profit-making firms also may provide water service to community residents. Because these entities are privately owned and exist to produce a profit, they are legally distinct from other water supply institutions. A private profit-making water system can be organized as an individual proprietorship (a single owner), a partnership (two or more owners) or a corporation. The creation of either a proprietorship or a partnership is relatively free of state legal requirements. However, the owners are personally responsible for financial losses of the operation.

A corporation is a legal entity under Texas law. The private corporation can be distinguished from the proprietorship and partnership by the fact that the owners do not have direct personal liability for the firm's financial losses. The entity may be owned by a single person or an association of persons. The State of Texas requires organizers of a private water system to obtain a charter before the firm can operate as a corporation within the state. As outlined in Table 6-3, the prospective water supply firm must file articles of incorporation with the Texas Secretary of State (16). The articles of incorporation legally establish the purpose of the corporation and the names of the incorporators. The Secretary of State will issue a certificate of incorporation if the articles conform to the law. An overview of the procedures for incorporation of a profit corporation appears in Appendix B (17).

Private water systems are often organized in unincorporated regions where no local government is responsible for the water supply function. In such cases there is no need for approval from the voters or public officials. The private water system need only file the appropriate organizational papers with the state. Other functions, in addition to water supply, may be performed by the private firm, although the corporation must list those functions in its articles of incorporation.

Despite the ease of implementation, private water systems may have operational drawbacks with respect to cost efficiency and compliance with federal standards. The private water system is unlikely to possess the organizational or financial capabilities to serve a large enough region to gain economies of scale. This situation may reflect private

TABLE 6-1: FUNCTIONAL RESPONSIBILITIES OF TEXAS GENERAL LAW WATER DISTRICTS

		FUNCTION										
*Type of District**	*Statutory Authorization†*	*Flood Control*	*Hydroelectric Power*	*Navigation*	*Parks and Recreation*	*Solid Waste Disposal*	*Thermal Power*	*Water Conservation*	*Water Quality and Sewage Treatment*	*Water Resource Data Collection*	*Water Supply*	*Irrigation and Drainage*
Drainage District	56											●
Fresh Water Supply District	53							●			●	
Levee Improvement District	57											●
Municipal Utility District	54	●	●	●	●	●	●	●	●	●	●	
Navigation District	62			●							●	
Underground Water Conservation District	52							●				
Water Control and Improvement District	51	●	●	●				●	●		●	
Water Improvement District	55		●				●				●	●

*Water districts authorized by Article 14, Section 59 of the Texas Constitution.

†Article, Vernon's Texas Codes Annotated.

TABLE 6-2: FUNCTIONAL RESPONSIBILITIES OF TEXAS RIVER AUTHORITIES, 1977

		Function							
River Authority	*Statutory Authorization**	*Flood Control*	*Hydroelectric Power*	*Navigation*	*Parks and Recreation*	*Solid Waste Disposal*	*Thermal Power*	*Water Conservation and Supply*	*Water Quality and Sewage Treatment*
Brazos River Authority	Article 8280-101	●	●		●			●	●
Canadian River Municipal River Authority	Article 8280-154	●			●			●	
Central Colorado River Authority	Article 8280-111							●	
Colorado River Municipal Water District	Article 8280-137				●			●	●
Guadalupe-Blanco River Authority	Article 8280-105 8280-106	●	●		●			●	●
Lavaca-Navidad River Authority	Article 8280-131								
Lower Colorado River Authority	Article 8280-107	●	●	●	●		●	●	●
Lower Neches Valley Authority	Article 8280-103							●	●
Lower Neches River Water Supply District	Article 8280-134							●	
Neches River Conservation District	Article 8280-108								●
Northeast Texas Municipal Water District	Article 8280-147							●	
North Texas Municipal Water District	Article 8280-142							●	●
Nueces River Authority	Article 8280-115							●	
Palo Duro River Authority	Water Auxiliary Laws								
Red Bluff Water Power Control District	Created by Texas Water Commission		●		●			●	●
Red River Authority of Texas	Article 8280-228							●	●
Sabine River Authority	Article 8280-133		●		●			●	●
San Antonio River Authority	Article 8280-119	●			●			●	●
San Jacinto River Authority	Article 8280-121							●	●
Trinity River Authority of Texas	Article 8280-188	●			●	●		●	●
Upper Colorado River Authority	Article 8280-109	●						●	
Upper Guadalupe River Authority	Article 8280-124	●						●	●
Upper Neches River Municipal Water Authority	Article 8280-157							●	●
West Central Texas Municipal Water District	Article 8280-162							●	
White River Municipal Water District	Article 8280-198				●			●	

*All Articles cited to Vernon's Annotated Civil Statutes, unless otherwise noted.

Adapted from Anon., "Handbook of Governments in Texas, Austin, Texas: Texas Advisory Commission on Intergovernmental Relations, State of Texas, 1973.

TABLE 6-3: PROCEDURE FOR OBTAINING STATE AUTHORIZATION TO INCORPORATE

1. Complete duplicate copies of articles of incorporation.
2. Verify articles of incorporation before a Notary Public.
3. Deliver originals of the articles of incorporation to Secretary of State.
4. Secretary of State reviews and approves/disapproves articles of incorporation.
5. Secretary of State issues certificate of incorporation to organizers.

water system dependence on cooperation with local governments to organize existing incorporated areas. Local governments may not cooperate if they are unable to have considerable control over the private entity and must support the higher rates prompted by the profit motive. The prospect of a private water system in an existing community may also be viewed with ambiguity by investors wary of the power of local eminent domain.

A private water supply system has powers similar to any other private firm and no powers of governance. To be successful, such a private water system must rely on the free enterprise system and cooperation from the local government.

Nonprofit Water Supply Corporations

A nonprofit water supply corporation is a quasi-public entity established under law to provide water service. This kind of water supply corporation is required by state law to operate on a not-for-profit basis. Profits from annual operations must be applied to past indebtedness, redistributed proportionally to water service customers, or allocated to a sinking fund for maintenance and improvement of the system.

A nonprofit water supply corporation may be formed by three or more Texas citizens who apply for a charter from the Texas Secretary of State. The application procedures are similar to those used to organize a private, profit-making corporation as described in Table 6-3. An overview of the procedures for incorporation of a nonprofit corporation appears as Appendix C (18).

The nonprofit water supply corporation tends to serve unincorporated regions for many of the same reasons as the private systems. Although the creation of a nonprofit water supply system also follows a state-prescribed administrative procedure, the entity is vested with a wider range of powers than those of a private system. As a quasi-public concern, it can pursue areawide service in incorporated communities; as a nonprofit institution, it is more accountable to its customers.

A properly chartered nonprofit water supply corporation has the right to acquire water sources and to construct and operate a water distribution system. These quasi-public corporations can, with the consent of the governing body of the municipality, exercise eminent domain to acquire rights of way or lay distribution pipes under streets (19). Because the corporation is not a governmental entity, it has no power to tax or issue general obligation bonds. Water supply corporations may issue bonds that are secured by encumbered properties and their revenues.

ORGANIZATIONAL ADAPTATION

Within the past decade, inflationary pressures have contributed to increasing costs for equipment, labor, and materials in the water supply industry. These rising operating costs have been translated into higher water charges to customers. The federal government has compounded the cost pressures for some water systems by establishing national quality standards for drinking water. These new standards may require a number of systems to install expensive treatment equipment to comply with the law. The cost of compliance may be financed through increases in the water rates. However, systems already facing high costs may find it difficult to meet these standards and charge rates that consumers can afford. Organizational adaptation may provide an effective means of complying with federal water quality standards and realizing reduced costs of operation.

As the number of service connections is expanded, a water supply system may benefit from reduced unit costs for water, described as economies of scale (20). Economies of scale may be found in labor, administration, and construction costs associated with a single central water supply facility. For instance, a doubling in water volume is not likely to require double the labor force or administration. The construction of a central facility to supply water to twice the number of connections is not likely to require double the capital investment. On the financial side, it is often less expensive for a large firm to borrow than for a smaller firm, whether from a bank or through the bond market. A water supply system serving a larger area will more likely possess the financial resources necessary to solve a compliance problem. All this suggests that unit water costs could be reduced through an expansion in the number of service connections. One practical means of achieving this is through the expansion of the area served by a single water supply entity. A second means is to pool the resources of several systems to jointly (a) develop new and acceptable sources of water or (b) construct and operate a single treatment unit to upgrade the quality of the existing water supply source.

A cooperative water supply arrangement may take two basic approaches. In the first, called "procedural adaptation," each participating water system maintains an independent identity, but all cooperate in acquiring and/or treating water. The second approach involves the combining of water systems to form a new entity, which is a structural adaptation. The next sections review procedural and structural approaches to adapting water supply entities to meet more effectively the twin goals of lower cost and higher quality standards.

Procedural Adaptation–Water Supply Service Contracts

A procedural adaptation is an institutional arrangement whereby the participating water systems obtain water from a central supply facility without forfeiting their independent organizational identities. Such cooperation results in the expansion of the area served by a single water facility. The term "water supply service contract" encompasses two distinct types of agreements, a "basic service contract" and a "joint service contract."

The basic service contract is a formal agreement for one or more parties to purchase a service from another party. This type of agreement is appropriate when one water supply system wishes to purchase water from or sell water to another water supply system.

A joint service contract establishes the participating jurisdictions as coequal partners in the provision of water. Planning, contracting, financing, and operating costs are shared among all parties, and administrative decisions are typically made by a joint governing body of representatives from each participating jurisdiction. The joint service contract is appropriate when two or more water supply entities wish to develop a new water source cooperatively.

Private water systems and nonprofit water supply corporations have long been able to enter into service contracts to purchase or sell water. Service contracting among governmental units in Texas was facilitated by the passage of a constitutional amendment in 1970. In response to this constitutional authorization, the Texas Legislature passed the Interlocal Cooperation Act of 1971. This act grants certain local jurisdictions the authority to enter into a joint agreement with other entities to perform any function which each could legally undertake alone. Any legally constituted political subdivision of the state (e.g., municipalities, counties, water districts, river authorities) may undertake interlocal contracting with similar political units, private water systems, and nonprofit water supply systems, subject to statutory restrictions (21).

The act limits the contracting powers of political subdivisions by providing that state statutes and local ordinances supercede the authority of the Interlocal Cooperation Act. For instance, there are specific grants of authority, some of which are listed in Appendix D, which take precedence over the act (22). Also the contracting authority of localities may be limited by local charter or ordinance.

It is difficult to generalize about the process of negotiating a service contract because these negotiations are influenced by the attitudes of the parties, the type of contracting being considered, and unique local circumstances. There is, however, a sequence of steps which may facilitate successful negotiations, as listed in Table 6-4. Some adjustments to this outline may be needed to account for local variations in government structure and legal provisions (23).

As the table suggests, research should be conducted prior to the formal commencement of contract negotiations. A thorough understanding of the type and magnitude of water supply needs will allow a jurisdiction to select the most appropriate institutional arrangement. The community leaders should develop a list of specific requirements to aid in deciding whether or not to become party to the agreement.

The appointment of a contract coordinator by each party may help to facilitate communication throughout the negotiation process. The contract coordinator should oversee all stages of the negotiations and act as a primary contact person for other parties involved in the transaction.

Because a service contract is a legal instrument, it is important to consider carefully the language embodied in the document. The language of service contracts is seldom uniform in all respects, though there are certain provisions essential to any contract. A service contract outline, incorporating essential provisions, appears as Appendix E (24). A joint service contract will usually contain a clause establishing a joint governing body to administer the project. A carefully constituted governing body can assure all partners in the joint venture an opportunity for participation in decisionmaking.

One of the major reasons for the popularity of the basic service contract is that it does not severely restrict the autonomy of those purchasing the water. Basic service contracts do not require voter approval for governmental participation and can be terminated on relatively short notice.

A joint service contract tends to place more restrictions on the participating jurisdictions. Parties to such contracts are typically coequal partners with similar levels of administrative and fiscal responsibility. Agreements for the joint provision of services and joint construction and operation of water supply facilities require a substantial financial commitment which is necessarily embodied in a long-term contractual agreement. These characteristics tend to restrict future flexibility. A governing body which allows adequate representation of all interests can enhance, however, the likelihood for approval.

TABLE 6-4: RECOMMENDED STEPS IN NEGOTIATING A SERVICE CONTRACT

Step	*Action*	*Responsible Participant*	*Responsibility*
1	Feasibility Study	Administrative official responsible for water service.	Recommendation to proceed with contract negotiations if the study indicates that a basic or joint service contract is the most economical or desirable course of action
2	Resolution of Intent	City council, commissioners' court or other legislative body	Formal statement of governmental unit's ability and willingness to undertake the joint or basic water service contract being contemplated, authorizing staff to enter into negotiations
3	Negotiations	Chief administrator, administrative official responsible for water service, and legal counsel	Parties establish terms and conditions of agreement and identify which party is to prepare the contract instrument
4	Preliminary Contract	Legal counsel	Development of contract instrument which codifies verbal agreements and establishes legal safeguards for performance
5	Preliminary Review	Chief administrator, administrative official responsible for water service, and legal counsel	Legal and substantive review of preliminary instrument by all parties to identify areas of correction or modification
6	Final Negotiations	Chief administrator, administrative official responsible for water service, and legal counsel	Negotiation session to reconcile differences and reach agreement on terms of final instrument
7	Authorizing Resolution	City council, commissioners' court or other legislative body	Formal statement of authorization for appropriate official to sign on behalf of governmental unit
8	Execution	Appropriate officials as designated or otherwise responsible	Contract instrument signed, attested, properly reconciled and forwarded to appropriate parties
9	Implementation	Administrative official responsible for water service	Program implementation as provided in contract
10	Performance Evaluation	Administrative official responsible for water service with assistance of consultants as needed	Evaluation of contract performance (a) in advance of mandatory contract review or renegotiation dates or (b) at regular intervals through the life of the agreement

Adapted from table appearing in *Handbook for Interlocal Contracting in Texas*, Arlington, Texas: Institute of Urban Studies, University of Texas at Arlington, 1972.

Structural Adaptation:
Annexation, Consolidation, and Merger

A group of cooperating water systems may agree to join together legally for the purpose of achieving compliance with drinking water standards. Such amalgamation differs from procedural adaptation in that it entails a loss of organizational identity for one or more of the participating systems and is usually permanent. It involves a shift of policy control, fiscal responsibility, and operational authority. This subsection examines three major means of structural adaptation–annexation, consolidation, and merger.

Annexation

Annexation occurs when a water system extends its service boundaries to include a neighboring area. The presence of recognized boundaries implies an established water supply service area, set either by law (e.g., water districts and river authorities) or by corporate limits (e.g., incorporated communities). In contrast, the service areas of private water systems and nonprofit water supply corporations are not specifically recognized by law. Although private suppliers may expand their service areas, they cannot annex territory in a legal sense.

A municipal water system will ordinarily expand to a new territory when the municipality extends its corporate limits through annexation. Annexation procedures vary with the governmental character of the municipality. A general-law city must obtain a favorable annexation vote from the residents of the territory to be annexed. A home-rule city may unilaterally annex land within its extraterritorial jurisdiction by ordinance and without the consent of the area to be annexed.* A home-rule city may also extend water service to its extraterritorial jurisdiction by ordinance without invoking the annexation procedure.

A city may annex territory which is already being served by an existing private water system or nonprofit water supply corporation; it may then, if it wishes, invoke the power of eminent domain to acquire the water supply system.

The annexation of territory is not necessarily an irreversible action. If a city annexes territory, it must provide water services similar to those provided in other sections of the city. If the quality of service is inferior, a majority of the voters in the annexed area may petition for disannexation.

The State Legislature has provided some water districts and river authorities the power to annex land. These general-law water districts with this power must follow a procedure prescribed in the Texas statutes in order to annex land. The annexation procedures for special-act water districts and river authorities vary with the individual enabling law, but tend to be similar to those of general-law water districts.

General-law water districts ordinarily may annex land at the request of a single landowner or a majority of the landowners in an area. As noted in Table 6-5, a single landowner may petition the district governing board to include her/his land in the general law district (25). The governing board then holds a hearing on the request. Annexation takes effect with a favorable determination by the board and the proper recording of the resolution.

A general law water district may also annex land outside a district which is owned by numerous landowners if, as noted in Table 6-6, a majority of the landowners in the territory (or fifty landowners if the number of landowners is over fifty) must petition the governing board of the water district for annexation (26). After a hearing, the board votes on a resolution to add territory. If the board approves the request, annexation may be secured under one of two methods. Under some statutes the annexation may take effect when the board resolution is properly recorded. Other statutes require separate approval by a majority of the residents in both the existing water district and the territory to be added.

Consolidation

Consolidation refers to the joining together of two or more similar water systems, which lose their former identity in the formation of one water system. Texas law provides consolidation procedures for water districts, private water systems, and nonprofit water supply corporations. The laws that govern water district consolidation include both special legislative acts (for special districts) and general Texas statutes (for general law districts). As noted in Table 6-7, two basic steps are required for the consolidation of general law water districts: (a) the governing boards of each district must first agree on the terms and conditions of consolidation, and (b) the voters of each district must ratify the action. Voter reaction to consolidation should focus on cost, quality of water, and dependability of service; fiscal and administrative autonomy should be of minor concern as those issues would be settled prior to the initial creation of a water district.

Texas statutes also provide for consolidation of private water supply systems and of nonprofit water supply corporations. In either case, the board of directors of the corporations involved in the consolidation must first set forth terms and conditions in a formal plan. The directors of each corporation then hold separate meetings, during which the proposed plan must be approved by a majority

*Extraterritorial jurisdiction refers to a ring of land, one-half to five miles beyond the city's corporate limits, depending on the size of the city's population.

TABLE 6-5: ANNEXATION PROCEDURES FOR GENERAL LAW WATER DISTRICTS UPON PETITION OF LANDOWNER

General Law Water District	*Statutory Citation*	*Procedure*
Water Control and Improvement District	VTCA*, Water Code 51.714-51.717	1. Petition by landowner to district governing board requesting that the described land be included in the district. 2. Hearing and favorable determination by district governing board. 3. Annexation takes effect when resolution is properly recorded.
Underground Water Conservation District	No Provision	No statutory procedure
Fresh Water Supply District	VTCA, Water Code 53.240-53.243	1. Petition by a majority of the landowners in the territory, or by 50 landowners if the number of landowners is over 50, to the district governing board requesting that the defined territory be included in the district. 2. Hearing by district governing board. 3. Resolution to add territory approved by the district governing board. 4. Annexation takes effect when resolution is properly recorded.
Municipal Utility District	VTCA, Water Code 54.711-54.715	Same procedure as for a Water Control and Improvement District.
Water Improvement District	VTCA, Water Code 55.725-55.729	Same procedure as for a Water Control and Improvement District.
Drainage District	No Provision	No statutory procedure
Levee Improvement District	No Provision	No statutory procedure
Navigation District	No Provision	No statutory procedure

*Vernons Texas Codes Annotated

Source: *Vernons Texas Codes Annotated*, St. Paul, Minnesota: West Publishing Company, 1978.

TABLE 6-6: ANNEXATION PROCEDURES FOR GENERAL LAW WATER DISTRICTS UPON PETITION OF MULTIPLE LANDOWNERS

General Law Water District	*Statutory Citation*	*Procedure*
Water Control and Improvement District	VTCA*, Water Code 51.718-51.724	1. Petition by a majority of landowners in the territory, or by 50 landowners if the number of landowners is over 50, to the district governing board requesting that defined property be included in the district. 2. Hearing by district governing board. 3. Resolution to add territory approved by governing board. 4. Annexation takes effect after approval of a majority vote of the electors at a separate election in the district and by a majority vote of the electors at a separate election held in the territory to be added.
Underground Water Conservation District	No Provision	No statutory procedure
Fresh Water Supply District	VTCA, Water Code 53.240-53.243	1. Petition by a majority of the landowners in the territory or by 50 landowners if the number of landowners is over 50, to the district governing board requesting that the defined territory be included in the district. 2. Hearing by district governing board. 3. Resolution to add territory approved by governing board. 4. Annexation takes effect when resolution is properly recorded.
Municipal Utility District	VTCA, Water Code 54.716-54.721	Same procedure as for a Fresh Water Supply District.
Water Improvement District	VTCA, Water Code 55.730-55.735	Same procedure as for a Water Control and Improvement District.
Drainage District	No Provision	No statutory procedure.
Levee Improvement District	No Provision	No statutory procedure.
Navigation District	VTCA, Water Code 62.291-62.299	1. Petition by 50 or a majority of landowners in adjacent territory requesting that the defined territory be included in the district. 2. Hearing and favorable determination by the district governing board. 3. Annexation takes effect with approval of a majority vote of the electors at a separate election held in the territory to be annexed.

*Vernons Texas Codes Annotated

Source: *Vernons Texas Codes Annotated*, St. Paul, Minnesota: West Publishing Company, 1978.

TABLE 6-7: CONSOLIDATION PROCEDURES FOR SIMILAR GENERAL LAW WATER DISTRICTS

General Law Water District	*Statutory Citation*	*Procedure*
Water Control and Improvement District	VTCA*, Water Code 51.732-51.733	1. The governing boards of each district agree on terms and conditions of consolidation. 2. Consolidation takes effect with approval of a majority vote of the electors in each district.
Underground Water Conservation District	No Provision	No statutory procedure
Fresh Water Supply District	No Provision	No statutory procedure
Municipal Utility District	VTCA, Water Code 54.728-54.729	Same procedure as for Water Control and Improvement District.
Water Improvement District	VTCA, Water Code 55.750-55.751	Same procedure as for Water Control and Improvement District.
Drainage District	No Provision	No statutory procedure
Levee Improvement District	No Provision	No statutory procedure
Navigation District	VTCA, Water Code 62.202-62.203	1. Petition by 50 or a majority of landowners in an adjacent Article 16, Section 59 navigation district requesting that the adjacent district be included in the other district. 2. Hearing and favorable determination by the district governing board. 3. Approval of a majority vote of electors at a separate election held in the district to be added. 4. Annexation takes effect after postelection hearing by the governing board and the proper recording of a favorable resolution.

*Vernons Texas Codes Annotated

Source: *Vernons Texas Codes Annotated*, St. Paul, Minnesota: West Publishing Company, 1978.

vote. Upon approving the plan, the directors of each corporation call separate stockholders meetings, at which the stockholders vote whether to approve or reject the plan. An affirmative vote of the stockholders of each corporation, each group owning at least four-fifths of the corporations's outstanding shares, is required for approval. After stockholders' approval is received, articles of consolidation are filed with the Texas Secretary of State.

Merger

A merger occurs when one water supply system absorbs one or more other systems. The absorbing water supply system continues its corporate existence but takes over all rights, liabilities, franchises, and properties of the absorbed system. An absorbed system thereafter has no corporate existence.

Both private profit-making water systems and nonprofit water supply corporations in Texas can participate in mergers. Both water supply entities operate under the same merger procedure, as established by state law. The board of directors of both participating corporations develop and must approve an agreement of merger. Upon approval of the merger agreement by the directors, approval by holders of at least four-fifths of the outstanding shares of each corporation is required. The merger takes effect when the articles of merger are filed with the Texas Secretary of State.

METHODS OF FINANCING COOPERATIVE WATER SUPPLY DEVELOPMENT

Although a cooperative water service arrangement may provide a sufficient economic base to make the construction or improvement of water supply facilities feasible, the water system officials must still decide the manner in which the development will be financed. Each of the institutional entities reviewed in the previous section have the legal capacity to finance water supply development with operating funds or through the issuance of bonds, although bonds are subject to varying legal restrictions. Some of the water supply entities are eligible to seek financial or technical assistance from federal, state, or local governments. This section reviews the financing alternatives available to cooperative water supply entities.

Pay-As-You-Go Approach

The pay-as-you-go approach entails financing water facility construction, repair, and improvement entirely out of current revenues. Such revenues may be generated from general taxation, special assessments, and water service charges.

The two primary sources of tax revenue in Texas are the sales tax and the property tax. In Texas, the sales tax may be levied only by general purpose governments. Municipalities may, with approval from a majority of the voters in the incorporated jurisdiction, levy a 1 percent local sales tax as a supplement to the state sales tax of 4 percent (28). All sales tax revenues are collected by the State. Revenues yielded from the local sales tax are computed and returned by the State to the general purpose governments.

Water districts and general purpose governments may levy taxes on property located within their recognized boundaries. Taxation is on an ad valorem or "according to value" basis. The State Legislature has determined that certain types of real and personal property are subject to taxation. Real property refers to land and buildings. Personal property refers to tangible possessions (such as automobiles, household furniture, and similar items) and intangible possessions (such as corporate stock and bank stock).

The Texas Constitution limits the rate at which property may be taxed by general purpose governments. Home rule cities (population over five thousand) may levy a property tax of up to $2.50 on each $100 of assessed valuation (29). General-law cities (population under five thousand) have a tax rate ceiling of $1.50 per $100 valuation (30). Although the Texas Constitution does not restrict the property tax powers of water districts, the State Legislature has limited the taxing authority of districts by statute.

Many water systems charge a special assessment to each property served by the extension of a water distribution network. In this manner, special assessments place a major share of the burden of financing upon those persons who derive the greatest benefit from the improvement.

Water rates represent a type of user charge. Each person is charged for the amount of water consumed according to a predetermined rate schedule. Under this approach, a bill for service represents the benefit received by the consumer of the water.

One method used to accumulate current revenues is the maintenance of a reserve fund. A stipulated amount of revenue is set aside each year in order to accumulate sufficient funds to finance future capital projects. The reserve fund can be used in combination with borrowing by a small water system to finance nonrecurring capital projects while minimizing long-term debt.

Borrowing Funds

Few water systems are able to pay for major water system improvements entirely out of current revenues or reserve funds. Instead they may choose to finance a water project partially or entirely by incurring long-term debt. In Texas, certain municipalities, water districts, river authorities, nonprofit water supply corporations, and private water systems may borrow funds through the issuance of bonds,

time warrants, and certificates of obligation. This section will examine these methods of borrowing with a special emphasis on municipal bonds.

Time Warrants

A time warrant is an order drawn by a jurisdiction directing the financial officer to pay a specified amount to the bearer at a specified point in time. These debt instruments are issued in lieu of immediate cash payment for goods and services. Time warrants may be issued without the approval of the voters, although the jurisdiction must publish a notice of intent so that the electorate has an opportunity to petition for a referendum. Time warrants are subject to complex issuance requirements and ordinarily do not yield favorable borrowing terms. Therefore these debt instruments should be issued only when a small monetary amount does not merit the expense and inconvenience of a bond election.

Certificates of Obligation

Certificates of obligation are debt instruments which may be sold for cash (similar to bonds) or made payable in return for goods and services (similar to time warrants). Certificates of obligation may be financed from either taxes or revenues. Government jurisdictions need not secure voter approval prior to issuance unless the electorate petitions for a referendum. Certificates of obligation which are sold for cash also require the approval of the Texas Attorney General prior to issuance of the instrument.

Bonds

A bond is a promise of the issuer to pay a specified sum of money on a specified date and to pay periodically a specified rate of interest. The term municipal bond is used to encompass funded debt obligations issued by states, counties, municipalities, and water districts. The Texas Constitution allows these governmental jurisdictions to finance water supply system improvements by issuance of either general obligation bonds or revenue bonds, subject to statutory restrictions.

General obligation bonds pledge the full faith and credit of a government entity. That is, the ad valorem taxing power of the jurisdiction is pledged to pay interest on and retire the debt. General obligation bonds can only be authorized by the voters residing within the corporate limits of the jurisdiction proposing to issue the debt instrument.

Revenue bonds are not backed by the full faith and credit of the entity. The bonds are secured by the net income generated by the water supply facility. The legislative body of a governmental entity must authorize the sale of revenue bonds. Voter approval of the sales of municipal revenue bonds may not be required but may improve the marketability of the bonds (31).

Municipalities and some water districts are legally restricted on the amount of debt they may incur through the issuance of bonds. The Texas Constitution limits the bonded debt that municipalities may incur for water conservation and development to 25 percent of the assessed valuation of real property within the jurisdiction (32). Municipalities are also constrained by constitutional limits on the property tax rates and a mandatory percentage contribution to a local sinking fund for municipal debt issues (33). The sinking fund provision requires a municipality to retire no less than two percent of the total bond value each year. In contrast, there are no constitutional debt limitations placed on water districts. However, the Legislature has placed statutory fiscal limitations on some water districts.

The decision to issue bonded indebtedness does not assure that a jurisdiction will be able to borrow money nor that it can do so at a reasonable rate of interest. Investors are able to choose from a wide range of bond issues; they will select the issue that is most attractive in relation to other potential investments.

The borrowing terms available to a government jurisdiction will largely be determined by the general condition of the money market and the financial condition of the jurisdiction itself. Some of the qualities which attract potential investors to a local bond issue are listed in Table 6-8 (34). These qualities are often translated into bond ratings by independent private investor services, such as Dun and Bradstreet, Inc., Moody Investor Services, Inc., and Standard and Poors Corporation.

The ratings assigned by these services provide a basis for investors to make their financial investment decisions. The interest rate which a bond commands depends on the rating received by the service. The lower the financial risk, the higher the bond rating. Generally the highest ratings command the most favorable borrowing terms.

Not all bonds are rated by investor services. Often these rating organizations establish a minimum bond debenture value under which no rating will be assigned. These minimum bond values may affect bonds issued for limited water facility improvements. Although bonds without a rating can be sold, they may carry a higher interest rate.

A major advantage of general obligation bonds is that the "full faith and credit" pledge results in additional security for the investor. This reduced financial risk will ordinarily be reflected in lower interest rate payments by the borrowing jurisdiction. However, as noted previously, the state constitution limits the rate at which property may be taxed and thereby restricts the amount of revenue

TABLE 6-8:
ATTRACTIVE QUALITIES FOR LOCAL BOND ISSUES

1. A healthy local economy, fostered by affirmative public policy to encourage economic development;
2. a fair amount of diversified business and industry with a record of stable growth and reasonable prospects for future growth;
3. a growing population with a good age distribution and family income level;
4. a record of responsible and prudent financial management free of political machinations and with a good debt service free of defaults;
5. a low debt in relation to the size, wealth, and income of the residents and to the jurisdictions tax resources;
6. a diversified tax system, including a well-administered property tax imposed at a rate not out of line with those prevailing in the area;
7. relatively limited future borrowing needs; and
8. sound political leadership supported by a professionally competent staff and a citizenry interested and proud of its community.

Adapted from Ecker-Racz, L. Lazlo, *Its Your Business: Local and State Finance*, New York: National Municipal League, 1976, p. 147.

that may be raised to repay general obligation bonds. Given this situation, municipalities may desire to use general obligation bonds to finance only nonrevenue-producing facilties. Under this rule, a water supply facility which raises revenue through water service charges would be financed by revenue bonds.

Financial Assistance

The prospect of major capital expenditures can spur cooperating water systems to search for outside financial assistance. Various agencies of the state and federal governments can provide assistance to water systems in the form of grants and loans, as listed in Table 6-9 (35). A grant allows an outside source to fund a project without requiring the recipient to incur liability for repayment. A loan is a form of assistance which requires repayment to the lender.

Three federal agencies provide financial assistance for constructing and/or improving water supply facilities: (a) the Economic Development Administration (U.S. Department of Commerce); (b) the Farmers' Home Administration; and (c) the Department of Housing and Urban Development. These agencies provide loans and grants to water systems which meet program eligibility criteria. A description of the aid programs appears as Appendix F (36).

The Texas Department of Water Resources (TDWR) is the sole source of financial assistance for the construction and improvement of water supply facilities provided by the State of Texas. The TDWR can lend funds at a minimal interest rate to a local government or water district by purchasing that community's water supply facility construction bonds.

After an interview with the manager of the Water Development Fund at TDWR, the eligible jurisdiction may submit a letter of application for funding. Loan decisions are made after evaluation of the community need, the size of the project, the proposed repayment plan, and the community financial situation.* As a condition of acceptance, all jurisdictions receiving TDWR loans must comply with specified construction and building material standards. TDWR loans only finance raw water storage, conveyance and treatment facilities. No part of the treated-water distribution system is eligible for assistance.

Technical Assistance

Technical assistance is a term for nonfinancial forms of support to eligible jurisdictions. As noted in Table 6-10, agencies at the federal, state, and regional levels of government provide such supportive services (38). Technical assistance qualifies as a form of financial aid only in the sense that these services constitute an in-kind subsidy, so that a community would not pay real costs of improving drinking water quality.

The only federal technical assistance is an EPA advisory services program. EPA will counsel local governments and public water systems on drinking water issues. Appendix G lists eligibility requirements (39).

The Texas Department of Community Affairs is a state agency charged by statute to assist local governments in providing essential services such as supplying water. The department provides localities with technical assistance in water supply development and also acts as a referral agent.

---

*The TDWR recognizes the Texas constitutional prohibition against local governments incurring bonded indebtedness greater than 25 percent of the assessed property value. Similar constitutional restraints are not imposed on water districts. As a general rule, TDWR will not extend a loan to a water district for an amount greater than 10 percent of the assessed valuation (37).

TABLE 6-9: SOURCES OF FINANCIAL ASSISTANCE TO WATER SYSTEMS IN TEXAS

Agency	*Program*	*Type of Aid*	*FY 1977 Aid ($ millions)*		*FY 1977 Aid for Drinking Water Quality ($ millions)*	*Clients*
Farmer's Home Administration	Rural Water and Waste Disposal Systems	loans	$31.46	(Texas)	not available	political subdivisions, private or public non-profit corporations
		grants	$17.347	(Texas)	not available	
Economic Development Administration	Public Works Facilities	grants	$26.822	(Southwest)	not available	associations representing an EDA-designated area or EDC, such as: –political subdivisions –Indian tribes –private or public non-profit corporations
	Supplemental 304 Projects	grants & loans	$ 0.694	Texas allocations	not available	
Department of Housing and Urban Development	Community Development	grants	$21.073	(Texas)	not available	SMSA or non-SMSA local governments
Environmental ProtectionAgency	Safe Drinking Water Act	loans	$ 0.0	(U.S.)	$0.0	public water systems
Texas Water Development Board	Water Development	loans & research	$19.339	(Texas)	$0.067 in research	political subdivisions

TABLE 6-10: SOURCES OF TECHNICAL ASSISTANCE TO WATER SYSTEMS IN TEXAS

Agency	*Program*	*Type of Aid*	*FY 1977 Aid ($ millions)*	*FY 1977 Aid for Drinking Water Quality ($ millions)*	*Clients*
Environmental Protection Agency	technical assistance	counseling and information	–	–	political subdivisions and public water systems
Texas Department of Water Resources	water development	loans and research	$19.339 in loans	$0.067 in research	political subdivisions
Texas Department of Health	surveillance & technical assistance	laboratory testing	$4.300 (est.) in services	$4.3 (est.) in services	licensed water systems
Regional Councils of Governments	general activities	counsel	–	–	political subdivisions

Adapted from Junek, Larry and Aileen Whitfill, "Financial Assistance for Safe Water: A Guide to Small Water Systems on Obtaining Aid," Austin, Texas: Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin, 1978.

Within the state of Texas there are twenty-four regional councils of government which collectively serve 235 of the state's 254 counties. A regional council serves as a planning and coordinating organization for communities within its respective multicounty service area. Councils of government typically do not possess the economic means to provide financial assistance for water supply development but do furnish technical assistance to localities. Technical assistance may take the form of helping local governments document qualifications for federal or state financial assistance for local projects.

BUILDING SUPPORT

Sections II and III presented nine cooperative organizational strategies for water supply. Five water service arrangements constitute basic water supply entities–the municipal water system, the water district, the river authority, the private water system, and the nonprofit water supply corporation. Each of these entities may be viewed as an alternative to an existing water supply arrangement; several lend themselves to a cooperative effort. The other four water supply strategies–water service contracts, annexation, consolidation, and merger–provide for the adaptation of two or more existing water supply entities.

The particular type of water supply arrangement chosen for implementation will reflect a number of technological, economic, and political considerations. Certain issues may be expected to dominate political arguments on any proposed change in a water system arrangement–drinking water quality, administrative flexibility, and local autonomy. Each institutional arrangement has its advantages and disadvantages; each can evoke degrees of political opposition. The purpose of this section is to evaluate briefly the political implications of each organizational approach and to examine strategies for building political support among the populace or among members of a decisionmaking body.

The creation of any new institution, whether a municipal water system, water district, river authority, private water system, or nonprofit water supply corporation, will require the approval of various groups. Similar approval may be required for organizational or procedural changes in existing institutions. Actors may include the state legislature, a state administrative agency, the local governing body, and the voters of the district, as shown in Table 6-11. Each of these sources will require different support-building strategies for gaining approval.

Although cost or drinking water quality issues may motivate consideration of change in water supply arrangements, the issues of "local autonomy" and "organizational flexibility" will likely be at the center of political debates. Local residents may be reluctant to support the creation of a new water supply entity beyond their control. This concern will be enhanced if the change is viewed as permanent. Although not all water supply arrangements require voter approval, the approval of local governmental officials is almost always desirable. Local officials may challenge a water supply arrangement on grounds similar to those of their constitu-

TABLE 6-11: PROCEDURAL REQUIREMENTS FOR THE IMPLEMENTATION OF SELECTED WATER SUPPLY ARRANGEMENTS

SUPPLY ARRANGEMENT	*PROCEDURAL REQUIREMENTS*							
Type of Water Supply Entity	*Statutory Procedure*		*Administrative Approval by State Agency*	*Approval by Governing Body of Public Entity*	*Approval by Private Policy Board*	*Approval by Governing Body of Special Purpose District*	*Approval by Voters of Jurisdiction*	
	Yes	*No*						
SERVICE CONTRACT								
Home Rule Municipality	●*			●				
General Law Municipality	●*			●				
General Law Water District	●*					●		
Special Act Water District	●*					●		
River Authority	●*					●		
Private Water System	●				●			
Nonprofit Water Supply Corporation	●				●			
ANNEXATION								
Home Rule Municipality	●			●				
General Law Municipality	●			●			●	
General Law Water District	●†	●†				●	●	
Special Law Water District	●†	●†				●		
River Authority	●†	●†				●		
Private Water System		●						
Nonprofit Water Supply Corporation		●						
CONSOLIDATION								
Home Rule Municipality	●			●				
General Law Municipality	●			●				
General Law Water District	●†	●†				●‡	●‡	
Special Act Water District	●†	●†				●‡	●‡	
River Authority	●†	●†				●‡	●‡	
Private Water System	●		●		●			
Nonprofit Water Supply Corporation	●		●		●			
MERGER								
Home Rule Municipality		●						
General Law Municipality		●						
General Law Water District		●						
Special Act Water District		●						
River Authority		●						
Private Water System	●		●		●			
Nonprofit Water Supply Corporation	●		●		●			

*Subject to Interlocal Cooperation Act and respective enabling statutes.

†Presence of a statutory procedure varies with the type of jurisdiction.

‡Specified in the enabling law of those jurisdictions with a statutory procedure.

ents. Local officials generally desire water supply to be, at a minimum, directly accountable to the community.

Legislative Approval

An effective campaign to promote a water system arrangement which requires legislative approval has three basic components. Those components are: (a) familiarization with the decisionmaking process; (b) identification of the roles and positions of the likely participants in the process; and (c) building support among these participants. The nature of the decisionmaking process varies among the levels of government and from community to community. Those closest to the process will best understand the motivations of its political participants. The building of a consensus is related to the approach and organization of the project supporters.

One method of building a consensus among local legislative members is through one-to-one communication. Having carefully identified the roles and motivations of the legislative participants, the advocate is prepared to lobby on behalf of the project. Some of the factors associated with effective advocacy are listed in Table 6-12 (40).

Although most persuasion will be done on an interpersonal basis, there are often opportunities for effective advocacy through the use of public presentations. Presentations targeted for a legislative body should utilize visual aids as supplemented by a written analysis of the proposal. Appendix H provides a summary of the costs, advantages, and disadvantages of various presentation modes (41).

Voter Approval

A campaign to gain public approval for either an institutional structure or a financial instrument requires substantial planning and organization.

The campaign may be organized to provide for a campaign chairperson and a supporting system of committees. The first step is to select a well-respected community member to be the chairperson for the campaign. He or she should have the time to devote to coordinating the campaign activities. A steering committee of prominent local citizens might be organized to emphasize the community-wide support for the campaign. Prospective steering committee members might include leaders of the business, civic, educational, labor, religious, and minority communities. The role of the steering committee will vary with the campaign. Often community leaders may agree to lend their names to a steering committee with the understanding that prior time commitments take precedence over the campaign. In other instances, steering committee members may elect to take an active role in the campaign. The campaign chairperson thus must have a clear definition of the role of the steering committee prior to contacting prospective members.

TABLE 6-12: ELEMENTS OF EFFECTIVE ADVOCACY

Element	*Description*
Credibility	The decisionmaker must have confidence in the advocate. He/she must have a high regard for the advocate's competence in the subject and personal integrity.
Context	An advocacy program should take the local environment into account and provide for participation and discussion.
Content	The message must have meaning and relevance to the decisionmaker. In general, decisionmakers select those alternatives which have the greatest rewards to their constituency.
Clarity	The message should be put in non-technical terms. Words must mean the same thing to the decisionmaker as to the advocate. Complex issues must be compressed into straightforward, clear and declarative sentences.
Continuity and Consistency	Advocacy requires repetition to achieve penetration. Repetition with variation contributes to both factual and attitudinal learning. The message must be consistent.
Channels	Established channels of communication should be used, channels which the decisionmaker uses and respects.
Capability of Audience	Advocacy must take into account the capability of the decisionmaker. Communications are most effective when they require the least effort on the part of the decisionmaker. The advocate should consider such factors as availability, habit, reading ability, and the decisionmaker's level of knowledge about the general subject area.

Adapted from Cutlip, Scott H. and Allen H. Centor. *Effective Public Relations*, Englewood Cliffs, New Jersey: Prentice-Hall, 1958, pp. 140-141.

At the formal announcement of the organization of the campaign, the chairperson and steering committee should announce plans for the formation of a number of support committees. These committees will provide an avenue of involvement for community members. A serious and definite time commitment is of key importance for members of the support committees. These committees might be

established in the areas of public relations, finance, endorsements, and speaking engagements.

A public relations committee should work to provide public exposure for the campaign. It would be wise to include persons with advertising, journalism, and public relations experience as members of this committee. Such a committee could prepare campaign materials, develop press releases, coordinate news media coverage, purchase radio and television time, and obtain newspaper space for paid advertising.

The primary responsibilities of a campaign finance committee are to solicit funds, coordinate fund raising efforts, account for all contributions, and file campaign finance statements. Sound business practices dictate that campaign expenditures should not exceed revenues. Committee members should have proven fund-raising skills.

The purpose of an endorsements committee is to solicit individual and group endorsements of the campaign. Members of the endorsements committee should be outgoing persons with the ability to explain convincingly the purpose of the campaign to community leaders.

A speakers committee would recruit speakers, acquaint them with the campaign material, and schedule their appearances. Speakers can include public officials, water system staff, or well-informed citizens such as attorneys, consultants, and others.

The appointment of a campaign chairperson and members of the steering and support committees would be the first step of the campaign timetable. The chairperson and the respective committees should then develop an overall campaign timetable. Such a timetable will vary with the specifics of the campaign. A rather elaborate campaign timetable appears as Table 6-13 (42). Smaller communities should focus on the essential campaign elements while maintaining a high level of planning and organization.

TABLE 6-13: CAMPAIGN TIMETABLE

A tightly organized campaign effort over a long period of time provides the best guarantee of success. A sample timetable appears below:

Minimum Working Days Before Election to Start	Days to Complete	Activity
97	5	Recruit chairperson
92	10	Recruit steering committee
82	1	Announce campaign organization
81	10	Recruit support committees
71	35	Raise funds
66	7	Plan basic literature
50	5	Recruit speakers bureau
49	10	Agree on general radio plan
49	7	Draft sample speeches
47	25	Pay bills
47	7	Print basic literature
47	5	Train speakers bureau
42	2	Reproduce sample speeches
40	40	Operate speakers bureau
40	40	Distribute basic literature
17	6	Write and plan TV scripts
16	5	Write radio scripts
11	5	Tape TV spots
11	4	Tape radio spots
6	6	Run radio spots
6	6	Run TV spots
5	2	Preview newspaper ads
2	2	Run newspaper ads

Adapted from Wilcox, William and James O'Brien; "How to Win Campaigns. *Judicature*, vol. 51, no. 1, June-July 1967, p. 25.

SUMMARY

Texas water law establishes the community's prerogative to decide the manner in which it will supply water to local residents. In the past, many communities have chosen to maintain independent water supply and distribution systems. However, economic and political considerations may prompt a reevaluation of traditional institutional arrangements. Cooperative water supply arrangements may provide a means for checking the rising cost of water service and minimizing any added expenses associated with achieving federal drinking water quality standards.

This paper has reviewed some of the issues that may confront water systems wishing to exercise their prerogative to enter into a cooperative water supply arrangement. State and local laws establish the parameters for organizational change and system financing. Although final community decisions will likely be shaped by legal, economic, and political influences, there are a wide variety of institutional options available for implementation.

The paper has examined the alternatives in terms of both basic water supply arrangements and organizational adaptations that may facilitate cooperation. Five types of water supply arrangements were discussed: the municipal water system, the water district, the river authority, the private profit-making water system, and the nonprofit water supply corporation.

The change to a cooperative water supply arrangement may take either of two approaches. First, water systems may combine to form a new entity, a structural adaptation. This may involve annexation, consolidation, or merger. A second approach, called procedural adaptation, is one in which each of two or more water systems maintains an independent identity but all cooperate in acquiring and/or treating water. Water supply service contracts are a basic form of procedural adaptation.

Economic and political factors may impact on the final institutional form. The water supply development may be financed through a variety of methods, each possessing distinct legal and economic features. Both institutional form and financing method will be subject to political scrutiny, a topic deserving careful consideration in any development plan.

Passage of the Safe Drinking Water Act underscored the public concern for health and safety. Cooperative water supply arrangements may provide a means to facilitate compliance as well as reduce water supply expenditures. However, successful impelementation will require the careful coordination of the administrative, financial, legal, and political aspects of any arrangement.

REFERENCES

(1) Jeffrey, Edgar, U.S. EPA/Region VI.
Telephone interview by David Eaton in Dallas, Texas, April 1979.

(2) Information compiled from Texas Department of Health records by Pablo Collins and Richard Gowen, 1978.

(3) Eaton, David J., and the Safe Drinking Water Policy Research Project.
"Options for Coping with the Safe Drinking Water Act," in Clifford Russell, editor, *Safe Drinking Water*, Baltimore, Maryland: The Johns Hopkins University Press, 1978, pp. 411-443.

(4) Vernons Annotated Civil Statutes, articles 4414(a) and 4415(a), in *Vernon's Civil Statutes of the State of Texas Annotated*, St. Paul, Minn.: West Publishing Co., 1976, as supplemented.

(5) Vernons Annotated Civil Statutes, article 1446(c), section 5.

(6) McNeely, John G., and Ronald D. Lacewell.
Surface Water Development in Texas, College Station, Texas, Texas A&M University, 1971, p. 7.

(7) *Ibid.*

(8) State of Texas, Water Rights Adjudication Act of 1967, sec. 7. Vernons Revised Civil Statutes Water Code, sec. 5.301 et seq.

(9) Vernons Texas Codes Annotated, sec. 5.011 and 5021, in *Vernon's Texas Codes Annotated*, St. Paul, Minn.: West Publishing Co., 1972, as supplemented.

(10) Texas Water Development Board.
Continuing Water Resource Planning and Development for Texas, Austin, Texas: Texas Water Development Board, 1977, vol. 2, p. IV-8.

(11) Vernons Texas Codes Annotated, sec. 5.021.

(12) Vernons Annotated Civil Statutes, art. 1107.

(13) Vernons Annotated Civil Statutes, art 1108.

(14) Constitution of the State of Texas, art. 16, sec. 59.

(15) Vernons Annotated Civil Statutes, art. 8280.

(16) Vernons Annotated Civil Statutes, Business Corporation Act, art. 3.03.

(17) "Incorporation of a Profit Corporation," Austin, Texas: Office of the Texas Secretary of State, undated form.

(18) *Ibid.*

(19) Vernons Annotated Civil Statutes, art. 1109(j)(3).

(20) Moberg, Walter J.
The Cost of Supporting Rural Water Systems: Projections and Policies, Chicago, Illinois: Commission on Rural Water, 1976, p. 77.

(21) State of Texas, Interlocal Cooperation Act of 1971. Vernon's Revised Civil Statutes 1948, art. 4413 (32c).

(22) Institute of Urban Studies.
Practitioners Guide to Interlocal Cooperation, Arlington, Texas: Institute of Urban Studies, University of Texas at Arlington, 1975.

(23) Institute of Urban Studies.
Handbook for Interlocal Contracting in Texas, Arlington, Texas: Institute of Urban Studies, University of Texas at Arlington, 1972.

(24) National Association of Counties' Research Foundation.
Interlocal Service Contracting: A Practical Guide to Intergovernmental Arrangements for Local Officials, Washington, D.C.: National Association of Counties Research Foundation, mimeo, 1977, p. 32.

(25) Vernons Texas Codes Annotated, art. 51.7.4-51.717, 53.240-53.243, 54.711-54.715, and 55.725-55.729.

(26) Vernons Texas Codes Annotated, art. 51.718-51.724, 53.240-53.243, 54.716-54.721, 55.730-55.735, and 62.291-62.299.

(27) Vernons Texas Codes Annotated, art. 51.732-51.733, 54.728-54.729, 55.750-55.751, and 62.202-62.203.

(28) Safe Drinking Water Policy Research Project.
Impact of Safe Drinking Water Act on Texas, Austin, Texas: Lyndon B. Johnson School of Public Affairs, 1978, p. 60.

(29) Constitution of the State of Texas, art. 11, sec. 4.

(30) Constitution of the State of Texas, art. 11, sec. 5.

(31) Anderson, Lynn F., Professor of Public Affairs, Lyndon B. Johnson School of Public Affairs.
Interview by David Eaton in Austin, Texas, December 1978.

(32) Constitution of the State of Texas, art. 3, sec. 52, as amended by art. 16, sec. 59.

(33) Constitution of the State of Texas, art. 11, sec. 6.

(34) Ecker-Racz, L. Lazlo.
Its Your Business: Local and State Finance, New York: National Municipal League, 1976, p. 147.

(35) Junek, Larry, and Aileen Whitfill.
Financial Assistance for Safe Drinking Water: A Guide to Small Water Systems on Obtaining Aid, Austin, Texas: Lyndon B. Johnson School of Public Affairs, 1979.

(36) Office of Management and Budget, Executive Office of the President.
Catalogue of Federal Domestic Assistance, Washington, D.C.: Government Printing Office, 1977, pp. 32, 36, 83, 86, 453, and 454.

(37) Junek, Larry, and Aileen Whitfill, *op. cit.*

(38) *Ibid.*

(39) Office of Management and Budget, *op. cit.*, p. 821.

(40) Cutlip, Scott M., and Allen H. Center.
Effective Public Relations, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1958, pp. 140-141.

(41) Godfrey, Jan, and Jim Weaver.
Community Indicators for Your City, Austin, Texas: Lyndon B. Johnson School of Public Affairs, 1975.

(42) Wilcox, William, and James O'Brien.
"How To Win Campaigns," *Judicature*, vol. 51, no. 1, June-July 1967, p. 25.

APPENDICES

APPENDIX A

FINANCIAL OPTIONS FOR THE IMPROVEMENT OF WATER SYSTEMS

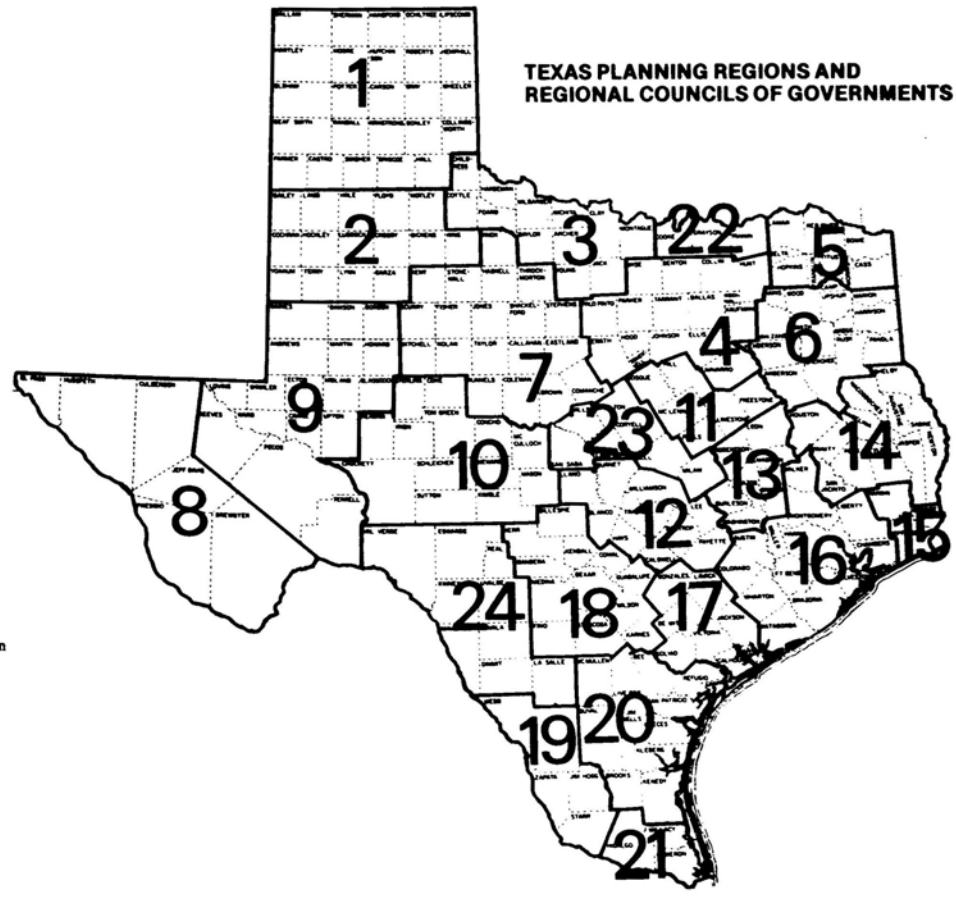
This paper has discussed federal and Texas programs that provide aid to communities for water system improvements. This appendix provides lists of relevant addresses and program criteria.

Illustration A-1 is a map showing the locations of the twenty-four COGs. A map of EDA Redevelopment Areas in Texas is presented in Illustration A-2.

List A-1 contains the administrative addresses of the COGs. List A-2 provides addresses of FmHA district offices in Texas. List A-4 shows the addresses of EDA offices in Texas. HUD office addresses in Texas are shown in List A-6.

List A-3 contains a sample checklist of procedure for applying for a loan or grant. List A-5 contains the criteria for EDA Redevelopment Area designation. List A-7 presents the HUD Block Grant eligible activities.

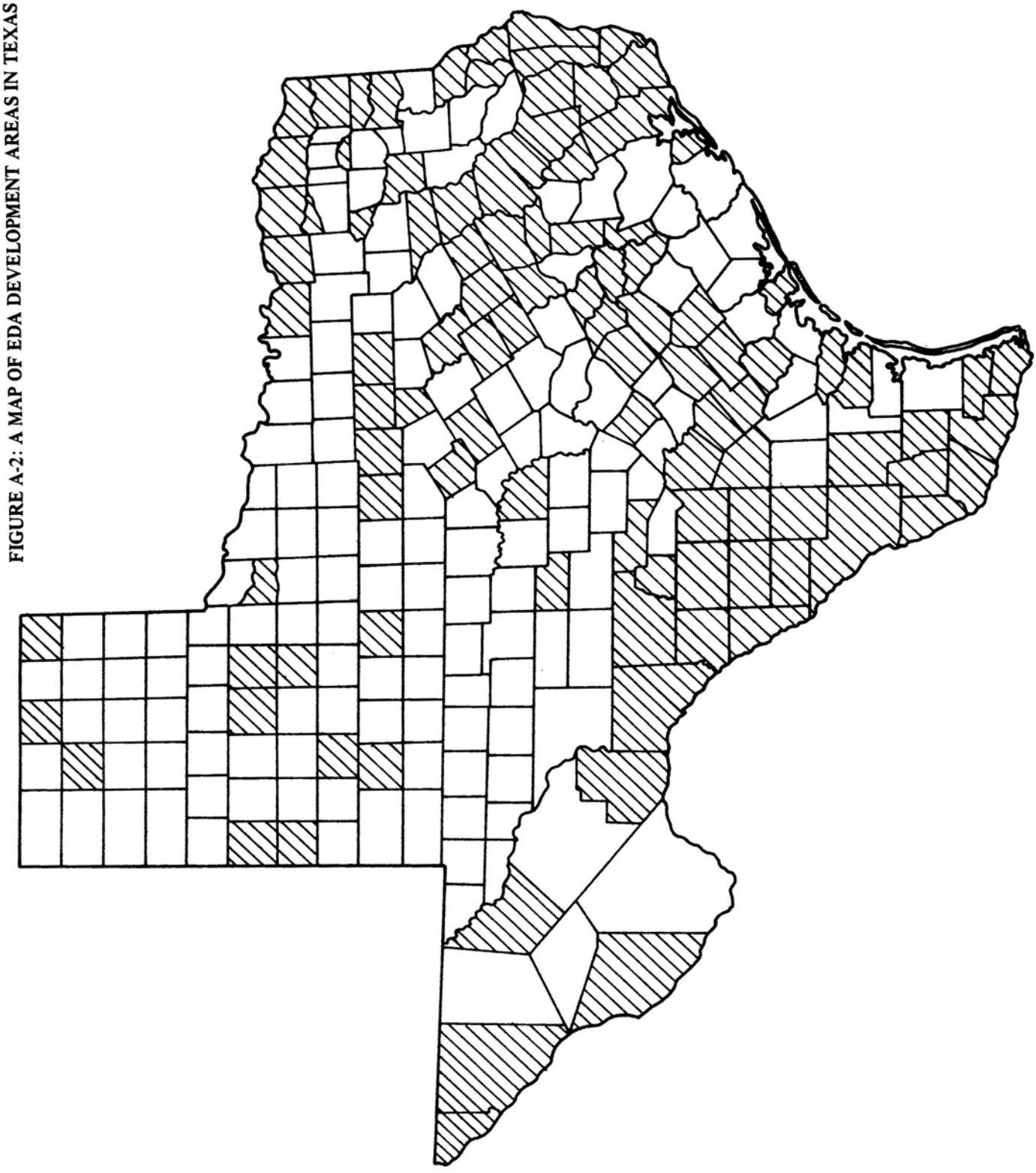
FIGURE A-1: LOCATION OF TEXAS REGIONAL COUNCILS OF GOVERNMENT



Region Number	Regional Council
1	Panhandle Regional Planning Commission
2	South Plains Association of Governments
3	Nortex Regional Planning Commission
4	North Central Texas Council of Governments
5	Ark-Tex Council of Governments
6	East Texas Council of Governments
7	West Central Texas Council of Governments
8	West Texas Council of Governments
9	Permian Basin Regional Planning Commission
10	Concho Valley Council of Governments
11	Heart of Texas Council of Governments
12	Capital Area Planning Council
13	Brazos Valley Development Council
14	Deep East Texas Council of Governments
15	South East Texas Regional Planning Commission
16	Houston-Galveston Area Council
17	Golden Crescent Council of Governments
18	Alamo Area Council of Governments
19	South Texas Development Council
20	Coastal Bend Council of Governments
21	Lower Rio Grande Valley Development Council
22	Texoma Regional Planning Commission
23	Central Texas Council of Governments
24	Middle Rio Grande Development Council

Source: Advisory Commission on Intergovernmental Relations *Handbook of Governments in Texas*, Austin, Texas, March 23, 1973, p. 180.

FIGURE A-2: A MAP OF EDA DEVELOPMENT AREAS IN TEXAS



LIST A-1: REGIONAL COUNCILS OF GOVERNMENT

NAME	ADDRESS	NAME	ADDRESS
Alamo Area Council of Governments (AACOG)	400 Three Americas Building San Antonio, Texas 78205 (512) 225-5201	Lower Rio Grande Valley Development Council (LRGVDC)	First National Bank Building, Suite 207 McAllen, Texas 78501 (512) 682-3481
Ark-Tex Council of Governments (ATCOG)	P. O. Box 5307 Texarkana, Texas 75501 (214) 794-3481 and (501) 774-3481	Middle Rio Grande Development Council (MRGDC)	P. O. Box 1461 Del Rio, Texas 78840 (512) 775-1581
Brazos Valley Development Council (BVDC)	P. O. Drawer 4128 Bryan, Texas 77801 (713) 822-7421	Nortex Regional Planning Commission (NRPC)	1914 Kemp Boulevard Wichita Falls, Texas 76309 (817) 322-5281
Capital Area Planning Council (CAPCO)	611 South Congress Suite 400 Austin, Texas 78704 (512) 443-7653	North Central Texas Council of Governments (NCTCOG)	P. O. Drawer COG Arlington, Texas 76011 (817) 640-3300
Coastal Bend Council of Governments (CBCOG)	P. O. Box 6609 Corpus Christi, Texas 78411 (512) 854-3081	Panhandle Regional Planning Commission (PRPC)	P. O. Box 9257 Amarillo, Texas 79105 (806) 372-3381
Central Texas Council of Governments (CTCOG)	P. O. Box 729 Belton, Texas 76513 (817) 939-1801	Permian Basin Regional Planning Commission (PBRPC)	P. O. Box 6391 Midland, Texas 79701 (915) 563-1061
Concho Valley Council of Governments (CVCOG)	7 West Twohig Building San Angelo, Texas 76903 (915) 653-1214	South East Texas Regional Planning Commission (SETRPC)	P. O. Drawer 1387 Nederland, Texas 77627 (713) 727-2384
Deep East Texas Council of Governments (DETCOG)	P. O. Drawer 1170 Jasper, Texas 75951 (713) 384-5704	South Plains Association of Governments (SPAG)	1611 Avenue M Lubbock, Texas 79401 (806) 762-8721
East Texas Council of Governments (ETCOG)	Allied Citizens Bank Building, Fifth Floor Kilgore, Texas 75662 (214) 984-8641	South Texas Development Council (STDC)	P. O. Box 2187 Laredo, Texas 78041 (512) 722-3995
Golden Crescent Council of Governments (GCCOG)	P. O. Box 2028 Victoria, Texas 77901 (512) 578-1587	Texoma Regional Planning Commission (TRPC)	1000 Arnold Boulevard Denison, Texas 75020 (214) 786-2955
Heart of Texas Council of Governments (HOTCOG)	110 South 12th Street Waco, Texas 76701 (817) 756-6631	West Central Texas Council of Governments (WCTCOG)	P. O. Box 3195 Abilene, Texas 79604 (915) 672-8544
Houston-Galveston Area Council (H-GAC)	3701 W. Alabama Houston, Texas 77027 (713) 627-3200	West Texas Council of Governments (WTCOG)	Mills Building, Suite 700 303 N. Oregon Street El Paso, Texas 79901 (915) 532-2910

Source: Texas Advisory Commission on Intergovernmental Relations, *Handbook of Governments in Texas.* Austin, Texas, March 23, 1973, p. VI-10.

LIST A-2: FARMERS HOME ADMINISTRATION OFFICES

State Office:
101 South Main
Temple, Texas 76501
(817) 773-1711

District Offices:

District 1
109 Federal Building
Tyler, Texas 75702
(214) 595-0774

District 2
218 Federal Building
1205 Texas
Lubbock, Texas 79401
(806) 762-7641

District 3
Agricultural Building
E. Liveoak & Crockett Streets
P. O. Box 630
Seguin, Texas 78155
(512) 379-0930

District 4
Federal Building, Room 9A15
819 Taylor
Fort Worth, Texas 76102
(817) 334-3347

District 5
200 E. 1st Street
Bonham, Texas 75418
(214) 583-8531

District 6
204 S. Van Buren Street
P. O. Box 1218
Mount Pleasant, Texas 75455
(214) 572-7923

District 7
1413 West Third Street
Pecos, Texas 78772
(915) 445-2014

District 8
Eastland National Bank Building,
Room 312
Eastland, Texas 76448
(817) 629-1414

District 9
101 South Main
Temple, Texas 76501
(817) 773-1711

District 10
320 North Street
1st Federal Plaza Building, Suite 109
P. O. Box 748
Nacogdoches, Texas 75961
(713) 564-0232

District 11
7188 Alpine Drive
Kerrville, Texas 78028
(512) 896-4911

Source: Texas Advisory Commission on Intergovernmental Relations, *Handbook of Governments in Texas.* Austin, Texas, March 23, 1973, p. VI-28.

LIST A-3: SAMPLE CHECKLIST OF PROCEDURES FOR APPLYING FOR FmHA FINANCIAL ASSISTANCE

AD 621	Pre-Application for Federal Assistance	_____
	Comments of the Council of Governments	_____
Ad 622	Notice of Pre-application Review Action	_____
AD 624	Application for Federal Assistance	_____
FmHA 440-46	Environmental Impact Assessment	_____
FmHA 442-3	Balance Sheet (sub. loans only)	_____
	Current Audit, Management Reports	_____
FmHA-Tx 442-4	Preliminary Certification of Users by District Director	_____
FmHA-Tx 442-6	Articles of Incorporation (only in initial loan) it maybe in other dockets	_____
FmHA 442-7	Initial Operating Budget	_____
FmHA-Tx 442-7	By-Laws (Nonprofit corporations)	_____
FmHA 442-9	Association Loan Resolution (nonprofit corporations)	_____
FmHA 442-10	Appraisal Report (where an existing facility is being purchased)	_____
	Option to purchase facility (include itemized list of chattels contained in system) Furnish lien search	_____
FmHA-Tx 442-13	Agreement for Legal Services	_____
FmHA 442-14	Association Project Fund Analysis	_____
FmHA 442-19	Agreement for Engineering Services	_____
FmHA 442-30	Water Purchase Contract (if applicable)	_____
FmHA 442-45	Project Summary–Water & Waste Disposal (utility type projects)	_____
	or	
FmHA 442-43	Project Summary–Community Facility	_____
FmHA 442-47	Loan Resolution (Public Body)	_____
	Preliminary Engineering Report	_____

Source: Farmer's Home Administration State Office, Temple, Texas, October 28, 1977.

LIST A-4: ECONOMIC DEVELOPMENT ADMINISTRATION OFFICES

Southwestern Regional Office
Economic Development Administration
221 W. 6th
Austin, Texas 78701
(512) 397-5461

Economic Development Administration,
Representative
Austin National Bank Building, Room 1402
Austin, Texas 78701
(512) 397-5119

Economic Development Administration,
Representative
1104 Victoria
Laredo, Texas 78040
(512) 724-8159

Economic Development Administration,
Representative
Federal Building, Room 416
1205 Texas
P. O. Box 2896
Lubbock, Texas 79408
(806) 762-7661

Source: Texas Advisory Commission on Intergovernmental Relations, *Handbook of Governments in Texas*. Austin, Texas, March 23, 1973, p. VI-33.

LIST A-5: CRITERIA FOR EDA REDEVELOPMENT AREA DESIGNATION

(1) substantial and persistent unemployment for an extended period of time, thus resulting in a substantial loss of population due to lack of economic opportunity (Secretary of Labor provides the data used in making the determination of this subsection);
(2) median family income is less than fifty percent of the national median family income;
(3) Indian lands which demonstrate the greatest degree of economic distress;
(4) unusual and abrupt rise in unemployment resulting from the loss, removal, curtailment, or closing of a major source of employment within a three-year period;
(5) additional areas designated redevelopment areas under Area Redevelopment Act;
(6) community or neighborhood defined without regard to political or other subdivisions or boundaries designated as public works impact program areas;
(7) designated special impact areas (no public works impact area or special impact area designated under this section shall be eligible to be considered a redeveloped area for the purposes of district designation;
(8) areas which have suffered a significant decline in per capita employment;
(9) redeveloped areas designated under the Community Services Act of 1974;
(10) areas which the Secretary of Labor determines were areas of substantial unemployment during the preceeding calendar year; or
(11) if a state does not have an area that qualifies, the Secretary designates an area as a redevelopment area, for the Act requires that every State must have at least one eligible area.

(With some exceptions redevelopment area must have a population of at least 1,500 and not over 250,000 persons. The size and boundary lines of redevelopment areas are determined by the Assistant Secretary.)

Source: Economic Development Administration, 13 Code of Federal Regulations 302-1-302.12.

LIST A-6: DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT OFFICE

Regional Office: Federal Building
1100 Commerce
Dallas, Texas 75242
(214) 749-7401

Area Offices: Department of Housing and Urban Development
2001 Byran Tower
Dallas, Texas 75201
(214) 749-1601

Department of Housing and Urban Development
110 South Main Avenue
P. O. Box 9163
San Antonio, Texas 78285
(512) 229-6800

Source: Texas Advisory Commission on Intergovernmental Relations, *Handbook of Governments in Texas*. Austin, Texas, March 23, 1973, p. VI-28.

LIST A-7: BLOCK GRANT ELIGIBLE ACTIVITIES

1. Acquisition of real property which is blighted; underdeveloped, or inappropriately developed; appropriate for conservation or rehabilitation; needed for eligible public works, needed for other public purposes.
2. Construction or installation of public works and facilities (includes water facilities).
3. Code enforcement in deteriorating areas.
4. Clearance demolition and rehabilitation of buildings.
5. Special projects to assist the mobility of elderly and handicapped persons.
6. Payments for temporary housing of persons displaced by community development activities.
7. Disposition of real property acquired as a result of the community development program.
8. Provision of public services not otherwise available in areas of concentrated activities if (a) they are appropriate to support other approved activities; or (b) application for aid to provide such services has been made under other Federal programs and has been denied or not made available within a reasonable period of time.
9. Payment of local match for federal grants.
10. Payment of cost of completing existing urban renewal projects.
11. Relocation payments.
12. Activities necessary to develop a comprehensive plan and a policy-planning-management capacity for community development activities.
13. Payment of reasonable administrative costs related to community development and housing activities, including costs for citizen input.

Source: Department of Housing and Urban Development, "Block Grant Eligible Activites," 24 *Code of Federal Regulations* 570.200.

APPENDIX B:

PROCEDURES FOR INCORPORATION OF A PROFIT CORPORATION

(AS PROMULGATED BY THE TEXAS SECRETARY OF STATE)

The Texas Business Corporation Act governs the incorporation of a profit organization. We regret there is no statutory authority for this office to publish or distribute general corporate forms or a digest of the laws.

Generally, these are some of the requirements: A corporation may be formed for any lawful purpose; and there must be one incorporator, who may be a natural person of the age of eighteen years or more. The corporation may be organized for a perpetual period of duration or less. It must designate a registered office by street or building address, and also designate a registered agent at such address. The Articles of Incorporation must include a statement that the corporation will not commence business until it has received for the issuance of its shares consideration of the value of $1,000.00. The board of directors, consisting of at least one member, must be named and their addresses given. The Articles of Incorporation must be verified, rather than acknowledged, and must be submitted in duplicate executed copies. The filing fee for such Articles of Incorporation is $100.00 regardless of the amount of capital stock. Franchise taxes are payable within ninety days after the expiration of one year from date of incorporation. Specific questions pertaining to franchise taxes should be directed to the Business Tax Division, Comptroller of Public Accounts, Capitol Station, Austin, Texas 78711.

In view of the legal technicalities involved, it is respectfully recommended that anyone contemplating the formation of a corporation consult with an attorney of his own choice in order that the Articles of Incorporation may be submitted in proper form.

Source: "Incorporation of a Profit Corporation," Austin, Texas: Office of the Texas Secretary of State, undated form.

APPENDIX C:

PROCEDURES FOR INCORPORATION OF NON-PROFIT CORPORATION

(AS PROMULGATED BY THE TEXAS SECRETARY OF STATE)

The Texas Non-Profit Corporation Act, which became effective on August 11, 1959, now governs the incorporation of a non-profit organization. We regret there is no statutory authority for this office to publish or distribute general corporate forms or a digest of the laws.

Generally, these are some of the requirements. A Corporation may be formed under the Texas Non-Profit Corporation Act for any lawful purpose, and there must be three incorporators, who are natural persons of the age of eighteen years or more, at least two of whom are citizens of the State of Texas. There must be a statement that the corporation is a non-profit corporation. The corporation may be organized for a perpetual period of duration or less, and must designate an initial registered office by street or building address and also designate an initial registered agent at such address. The board of directors (or trustees), of not less than three members, must be named and their addresses given. If the corporation is to have no members, there must be a statement to that effect. The Articles of Incorporation must be verified (sworn to before a Notary) rather than acknowledged, and must be submitted in duplicate executed copies. The filing fee for such Articles of Incorporation is $25.00, except for a church which is $10.00. Franchise taxes are payable within ninety days after the expiration of one year from date of incorporation, unless the corporation is exempt from payment under Article 12.03, Title 12A, Taxation-General, Vernon's Texas Civil Statutes. Such exemption must be claimed by writing to the Business Tax Division, Comptroller of Public Accounts, Capitol Station, Austin, Texas 78711.

In view of the legal technicalities involved, it is respectfully recommended that anyone contemplating the formation of a corporation consult with an attorney of his own choice in order that the Articles of Incorporation may be submitted in proper form.

Source: "Incorporation of Non-Profit Corporation; Austin, Texas: Office of the Texas Secretary of State, undated form.

APPENDIX D:

STATUTORY GRANTS OF AUTHORITY FOR INTERLOCAL WATER SUPPLY CONTRACTS

Texas statutes make specific grants of authority to political subdivisions for establishing interlocal water contracts. Several of these provisions are summarized in the following for reference purposes.

V.A.C.S. Article 4413(32c) (5)
The Interlocal Cooperation Act

This section authorizes agreements between cities, special districts or river authorities for the purpose of obtaining or providing water supply facilities and for the lease or operation of such facilities by one or more of the contracting parties. The agreement may provide that the party receiving services under the agreement may not obtain such services from any other source. No tax revenues may be pledged to the payment of obligations incurred by the agreement. The section grants contracting authority notwithstanding restrictions or limitations contained in other laws.

V.A.C.S. Article 1109a-3

This statute authorizes both home rule and general law cities to contract with each other or with certain water districts (created under Article XVI, Section 59 of the Texas Constitution) for a supply of untreated water and to construct, acquire, maintain, and operate water treatment facilities, reservoirs, pipelines, and water transporting facilities to provide these cities with a fresh water supply. The statute also authorizes the cities jointly participating to contract with other cities to supply water. No election is required to enter into agreements contemplated by this statute. The statute contains general obligation and revenue financing provisions.

V.A.C.S. Article 1109d

This statute authorizes any city to contract with Water Improvement Districts or Water Control and Improvement Districts (created under Article XVI, Section 59 of the Texas Constitution) for the purpose of supplying water to such city. The duration of the agreement cannot exceed thirty years or the life of outstanding bonds issued to finance the system. No contract is binding until approved by a vote of the electorate. The election procedure is prescribed in the statute. The act contains revenue and tax financing provisions.

V.A.C.S. Article 1109e

This statute authorizes any city to contract with water districts created under Article XVI, Section 59 of the Texas Constitution in order for: (a) the district to supply water to the city; (b) the city to lease its water production, supply and facilities to the district; (c) the district to operate the city's water production and supply facilities; or (d) the city to operate the district's water production and supply facilities.

The agreement may be in effect for the life of bonds issued to finance the system. The agreement must provide for rate revisions to accommodate operation and maintenance expenses and principal and interest on bonds secured by the agreement. The contract must be authorized for the city by a vote of the electorate at an election conducted in accordance with procedures prescribed in the statute.

V.A.C.S. Article 1109j

This statute authorizes any home rule or general law city to contract with districts created under Article XVI, Section 59 of the Texas Constitution, in order that the district may acquire for the benefit of the contracting city one or more water supply or treatment systems and improve, enlarge, or extend the same. The contract may provide for a city to become the owner of the system upon retirement of the debt incurred for acquisition and improvement. Contract payments may be provided to be paid from and served by system revenues or taxes. The agreement may also grant the district a right to use the city's streets and public ways. The contract may provide that the city shall operate the system. Such an agreement may be authorized by majority vote of the governing body of the city.

V.A.C.S. Article 2351

When a county has a subterranean water supply, it may contract to sell any water not needed by it to any city or other political subdivision of the state, including a water control and improvement district or fresh water supply district. Such water may be used or resold. The agreement cannot exceed a term of forty years. County revenues derived from contract payments become a part of the general fund of the county.

Water Code, Article 5.036

Any water improvement or irrigation districts having surplus stormwater, floodwater, or rainwater may contract to supply any other such district having a right to acquire the use of such water. The contract is subject to rate revision in order to pay operation and maintenance expenses, the principal, and interest costs.

Water Code, Article 51.189

A water control and improvement district created under Article III, Section 52 or Article XVI, Section 59 of the Texas Constitution may contract to pump for or supply another district with any water in which the latter district has a right.

Water Code, Articles 50-271—50-277

Any district or authority created under Article XVI, Section 59 of V.A.C.S. Article 1434a may contract with other such entities for water supply. The purchasing district may by contract be restricted regarding other sources of water. The term of such an agreement shall be for the life of bonds issued to finance the system. The rates payable under the contract are subject to revision to pay operations and maintenance expenses and principal and interest costs of the system. Contract payments from water revenues are deemed to be an operating expense of the paying district.

Water Code, Article 53.124

An eligible district (fresh water supply district and other districts, cities, or other political subdivisions) may by contract act jointly with other districts, cities, or other political subdivisions of the state to acquire water rights, distribute water, and exercise other powers granted to fresh water supply districts by Chapter 53 of the Water Code.

This appendix is based on legal research appearing in *Practitioners Guide to Interlocal Cooperation*, Arlington, Texas: Institute of Urban Studies, University of Texas at Arlington, 1975.

APPENDIX E: SERVICE CONTRACT OUTLINE

Certain elements are essential to all contractual arrangements. The outline below provides a framework for incorporating these elements into a contractual instrument.

1. NATURE OF THE ARRANGEMENT
   a. Description of parties involved
   b. Explanation of need for contract
   c. Citation of legal authority
   d. Definition of terms

2. LEVEL OF SERVICE–WORK TO BE PERFORMED

3. LIMITATIONS
   a. State statutes
   b. Local charters

4. SERVICE CHARGES
   a. Salaries
   b. Depreciation on equipment
   c. Overhead
   d. Office supplies
   e. Clerical work (support services)
   f. Employee fringe benefits
   g. Capital expenditures

5. ADMINISTRATION
   a. Units responsible for services
   b. Control over responsible units
   c. Joint governing body (applicable only to a joint service contract)
      - Number, title method of selection, term of office, compensation of officers, selection of chairperson
      - Number and frequency of meetings
      - Procedures and qualifications for voting and provisions/conditions for new membership

6. FISCAL PROCEDURES
   a. Reports
   b. Budgets
   c. Manner and time of payments

7. PERSONNEL RIGHTS
   a. Utilization of personnel
   b. Safeguards for civil service rights, privileges, immunities, and fringe benefits

8. STAFFING
   a. Procedures
   b. Terms

9. PROPERTY ARRANGEMENT

10. DURATION, TERMINATION, AND AMENDMENT

11. MONITORING AND EVALUATION

Source: *Interlocal Service Contracting: A Practical Guide to Intergovernmental Arrangements for Local Officials*, Washington, D.C.: National Association of Counties Research Foundation, mimeo, 1977, p. 32.

APPENDIX F: FEDERAL ASSISTANCE FOR WATER SUPPLY DEVELOPMENT

The following pages contain information concerning the types of federal financial assistance for water supply development, fund uses and restrictions, eligibility requirements, and application and award processes. The programs considered include: (a) Economic Development–Grants and Loans for Public Works and Development Facilities; (b) Economic Development–Public Works Impact Projects; (c) Water and Waste Disposal Systems for Rural Communities; (d) Community Facilities Loans; and (e) Community Development Block Entitlement and Discretionary Grants.

These programs utilize direct loans, guaranteed/insured loans, formula grants, and project grants as modes of financial assistance. Direct loans are provided through the lending of federal monies for a specific period of time with a reasonable expectation of repayment. Such loans may or may not require the payment of interest. Guaranteed/insured loans are available through programs in which the federal government makes an arrangement to indemnify a lender against part of all of any defaults by those responsible for repayment of loans. Formula grants involve allocations of money to states or their subdivisions in accordance with the distribution formulas prescribed by law or administrative regulation, for activities of a continuing nature not confined to a specific project. Project grants entail the funding, for fixed or known periods, of specific projects or the delivery of specific services or products without liability for failure to perform. Project grants include fellowships, scholarships, research grants, training grants, traineeships, experimental and demonstration grants, evaluation grants, planning grants, technical assistance grants, survey grants, construction grants, and unsolicited contractual agreements.

Source: Office of Management and Budget, Executive Office of the President, *Catalogue of Federal Domestic Assistance* (Washington, D.C.: U.S. Government Printing Office, 1977). Hereafter referenced as OMB *Catalogue*, p. ___ .

11.300 ECONOMIC DEVELOPMENT–GRANTS AND LOANS FOR PUBLIC WORKS AND DEVELOPMENT FACILITIES

FEDERAL AGENCY: ECONOMIC DEVELOPMENT ADMINISTRATION, DEPARTMENT OF COMMERCE

AUTHORIZATION: Public Works and Economic Development Act of 1965; Public Law 89-136, as amended; 42 U.S.C. 3131, 3132, 3135, 3141, 3171.

OBJECTIVES: To assist in the construction of public facilities needed to initiate and encourage long-term economic growth in designated geographic areas where economic growth is lagging behind the rest of the Nation.

TYPES OF ASSISTANCE: Project Grants; Direct Loans.

USES AND USE RESTRICTIONS: Grants for such public facilities as water and sewer systems, access roads to industrial parks or areas, port facilities, railroad sidings and spurs, public tourism facilities, vocational schools, flood control projects, and site improvements for industrial parks. Qualified projects must fulfill a pressing need of the area and must: (1) tend to improve the opportunities for the successful establishment or expansion of industrial or commercial plants or facilities, (2) assist in the creation of additional long-term employment opportunities, or (3) benefit the long-term unemployed and members of low-income families or otherwise substantially further the objectives of the Economic Opportunity Act of 1964. In addition, proposed projects must be consistent with the currently approved overall economic development program for the area, and for the district, if any, in which it will be located. JOINT FUNDING: This program is considered particularly suitable (eligible) for joint funding with closely related Federal financial assistance programs in accordance with the provisions of OMB Circular No. A-111. For programs that are not identified as particularly suitable or eligible for joint funding, applicant may consult the headquarters or field office of the appropriate funding agency for further information on statutory or other restrictions involved.

ELIGIBILITY REQUIREMENTS:

Applicant Eligibility: States, local subdivisions thereof, Indian tribes, and private or public nonprofit organizations or associations representing a redevelopment area or a designated economic development center are eligible to receive grants and loans. Corporations and associations organized for profit are not eligible.

Beneficiary Eligibility: Unemployed and underemployed persons and/or members of low-income families.

Credentials/Documentation: Application must describe the type of proposed facility, estimated costs, extent of proposed project, direct job impact, estimated time for construction implementation, and assurance that the project will satisfy statutory requirements. Most important, documentation must demonstrate how the project will have a positive impact on the economic development process in the community. Costs will be determined in accordance with FMC 74-4 for State and local governments.

APPLICATION AND AWARD PROCESS:

Preapplication Coordination: The Economic Development Administration Representative will meet with the applicant and community leaders to establish the basis for a preapplication conference. After reviewing project and local development profile information with the regional office, he will notify the applicant immediately if EDA cannot accept the project. If project appears viable, a preapplication conference may be arranged with regional office personnel. Applications should be reviewed under procedures in Part I of OMB Circular No. A-95 (revised). The standard application forms as furnished by the Federal agency and required by FMC 74-7 must be used for this program. An environmental assessment is necessary for this program.

Application Procedure: Applicant should contact the regional office servicing the State in which the project is to be located. An Economic Development Representative assigned as coordinator of the project for EDA will provide necessary forms and assist in filling them out. This program is subject to the provisions of OMB Circular No. A-110.

Award Procedure: Grant and loan applications from states, local subdivisions thereof, Indian tribes, and private or public nonprofit organizations or associations representing a redevelopment area or a designated economic development center are approved by the Assistant Secretary for Economic Development, Department of Commerce. Contract award should be made on the lowest base bid submitted by a responsible bidder, with a responsible bidder defined as one who can furnish 100 percent performance and payment bonds and who meets the applicable State and local statutory requirements. Notification of grant award must be made to the designated State Central Information Reception Agency in accordance with Treasury Circular 1082.

Deadlines: None.

Range of Approval/Disapproval Time: Normally within 90 days of acceptance of application.

Appeals: None.

Renewals: None.

ASSISTANCE CONSIDERATIONS:

Formula and Matching Requirements: The basic grant rate may be up to 50 percent of the project cost. Severely depressed areas that cannot match Federal funds may receive supplementary grants to bring the Federal contribution up to 80 percent of the project cost with designated Indian Reservations eligible for 100 percent assistance. Additionally, redevelopment areas located within designated economic development districts may, subject to the 80 percent maximum Federal grant limit, be eligible for a 10 percent bonus on grants for public works projects. Long-term (up to 40 years), low interest loans may be made to the applicant when financial assistance is not otherwise available from private lenders or Federal agencies on terms which would permit accomplishment of the project.

Length and Time Phasing of Assistance: EDA grant funds are disbursed for costs incurred only after all contracts for construction have been awarded. EDA loan funds are normally disbursed when the construction of the project is 75 percent or more complete.

POST ASSISTANCE REQUIREMENTS:

Reports: Reports for specific projects may be requested.

Audits: Each recipient of financial assistance is required to keep such records as will facilitate an effective audit of the project.

Records: As necessary for above-mentioned audit.

FINANCIAL INFORMATION:

Account Identification: 13-2050-0-1-452.

Obligations: (Grants) FY 76 $151,165,000; TQ $37,300,000; FY 77 $142,000,000; and FY 78 est $142,000,000. (Loans) FY 76 $13,000; TQ $620,000; FY 77 $2,500,000; and FY 78 est $2,500,000.

Range and Average of Financial Assistance: No specific minimum or maximum project amount. $5,000 to $7,138,000; $580,000.

PROGRAM ACCOMPLISHMENTS: In fiscal year 1976, 302 projects were approved for $208,378,948. In fiscal year 1977, an estimated 241 projects will be approved for $166,500,000.

REGULATIONS, GUIDELINES, AND LITERATURE: Title 13 CFR Chapter III, "Building Communities with Jobs," EDA. "Grants and Loans for Public Works and Development Facilities," EDA. "Qualified Areas under the Public Works and Economic Development Act of 1965," "Guides for Overall Economic Development Programs,' "Economic Development, Directory of Approved Projects.'

INFORMATION CONTACTS:

Regional or Local Office: Refer to the appendix of the catalog for EDA regional office addresses.

Headquarters Office: George T. Karras, Director, Office of Public Works, Economic Development Administration, Department of Commerce, Washington, DC 20230. Telephone: (202) 377-5265.

RELATED PROGRAMS: 11.301, Economic Development-Business Development Assistance; 11.302, Economic Development-Support for Planning Organizations; 11.303, Economic Development-Technical Assistance; 11.304, Economic Development-Public Works Impact Projects; 11.307, Economic Development-Special Economic Development and Adjustment Assistance Program; 11.308, Grants to States for Supplemental and Basic Funding of Titles I, II, III, IV and IX Activities; 11.309, Trade Adjustment Assistance; 15.124, Indian Loans-Economic Development; 23.001, Appalachian Regional Development; 28.001, Coastal Plains Regional Economic Development; 38.001, Four Corners Regional Economic Development; 48.001, New England Regional Economic Development; 52.001, Ozarks Regional Commission; 63.001, Upper Great Lakes Regional Economic Development; 75.01, Old West Regional Economic Development; 76.001, Pacific Northwest Regional Economic Development.

OMB *Catalogue*, p. 83.

11.304 ECONOMIC DEVELOPMENT–PUBLIC WORKS IMPACT PROJECTS

FEDERAL AGENCY: ECONOMIC DEVELOPMENT ADMINISTRATION, DEPARTMENT OF COMMERCE

AUTHORIZATION: Public Works and Economic Development Act of 1965; Public Law 89-136, as amended; 42 U.S.C. 3131, 3135.

OBJECTIVES: To provide immediate useful work to unemployed and underemployed persons in designated project areas.

TYPES OF ASSISTANCE: Project Grants.

USES AND USE RESTRICTIONS: Construction of public facilities to provide immediate jobs to the unemployed and underemployed in the project area. JOINT FUNDING: This program is considered particularly suitable (eligible) for joint funding with closely related Federal financial assistance programs in accordance with the provisions of OMB Circular No. A-111. For programs that are not identified as particularly suitable or eligible for joint funding, applicant may consult the headquarters or field office of the appropriate funding agency for further information on statutory or other restrictions involved.

ELIGIBILITY REQUIREMENTS:

Applicant Eligibility: States and their local subdivisions, Indian tribes, and private or public nonprofit organizations representing a redevelopment area or economic development center. Corporations and associations organized for profit are not eligible.

Beneficiary Eligibility: Unemployment and underemployed persons and/or members of low-income families.

Credentials/Documentation: Description of proposed facility, estimated costs, extent of proposed project, direct job impact, estimated time for construction implementation, and assurance that the project will satisfy statutory requirements. Most important, documentation must demonstrate how the project will have a positive impact on the economic development process in the community. Costs will be determined in accordance with FMC 74-4 for State and local governments.

APPLICATION AND AWARD PROCESS:

Preapplication Coordination: The Economic Development Administration Representative will meet with applicant and community leaders to establish basis for preapplication conference. After reviewing project and local development profile information with the regional office, he will notify applicant immediately if EDA cannot accept the project. If project appears viable, a preapplication conference may be arranged with regional office personnel. The standard application forms as furnished by the Federal agency and required by FMC 74-7 must be used for this program. An environmental assessment is necessary for this program. Applications should be reviewed under procedures in Part I of OMB Circular No. A-95 (revised).

Application Procedure: Applicant should contact the regional office servicing the State in which the project is to be located. An Economic Development Representative assigned as coordinator of the project for EDA will provide necessary forms and assist in filling them out. This program is subject to the provisions of OMB Circular No. A-110.

Award Procedure: Grant applications from states, local subdivisions thereof, Indian tribes, and private or public nonprofit organizations or associations representing a redevelopment area or a designated economic development center are approved by the Assistant Secretary of Economic Development, Department of Commerce. Contract award should be made on the lowest base bid submitted by a responsible bidder, with a responsible bidder defined as one who can furnish 100 percent performance and payment bond and who meets the applicable State and local

statutory requirements. Notification of grant award must be made to the designated State Central Information Reception Agency in accordance with Treasury Circular 1082.

Deadlines: None.

Range of Approval/Disapproval Time: Normally within 90 days of acceptance of application.

Appeals: None.

Renewals: None.

ASSISTANCE CONSIDERATIONS:

Formula and Matching Requirements: The basic grant rate for special impact areas is 80 percent except for Indian areas, where the rate can be 100 percent. Local matching share may be waived if appropriate governmental entity can demonstrate that it has exhausted its effective taxing and borrowing capacity.

Length and Time Phasing of Assistance: EDA grant funds are disbursed for costs incurred only after all contracts for construction have been awarded.

POST ASSISTANCE REQUIREMENTS:

Reports: Weekly payrolls of construction employees.

Audits: Each recipient is required to keep records that will facilitate an effective audit of project.

Records: As necessary for above-mentioned audit.

FINANCIAL INFORMATION:

Account Identification: 13-2050-0-1-452.

Obligations: (Grants) FY 76 $15,310,000; TQ $3,580,000; FY 77 $22,000,000; and FY 78 est $22,000,000.

Range and Average of Financial Assistance: Priority to projects of $600,000 or less; $220,000.

PROGRAM ACCOMPLISHMENTS: In fiscal year 1975, 49 projects were approved for $15,680,000. In fiscal year 1976, 60 projects were approved for $19,065,960. In fiscal year 1977, a total of $22,000,000 is allocated to this program.

REGULATIONS, GUIDELINES, AND LITERATURE: "Building Communities with Jobs, EDA"; "Grants and Loans for Public Works and Development Facilities, EDA"; Title 13, Code of Federal Regulations, Chapter III; "Qualified Areas under the Public Works and Economic Development Act of 1965;" Guides for Overall Economic Development Programs, Directory of Approved Projects.

INFORMATION CONTACTS:

Regional or Local Office: See appendix.

Headquarters Office: George T. Karras, Director, Office of Public Works, Economic Development Administration, Department of Commerce, Washington, DC 20230. Telephone: (202) 377-5265.

RELATED PROGRAMS: 11.300, Economic Development-Grants and Loans for Public Works and Development Facilities; 11.302, Economic Development-Support for Planning Organizations; 11.303, Economic Development-Technical Assistance; 11.307, Economic Development-Special Economic Development and Adjustment Assistance Program; 11.308, Grants to States for Supplemental and Basic Funding of Titles I, II, III, IV and IX Activities; 11.309, Trade Adjustment Assistance; 15.115, Indian Housing-Development; 23.001, Appalachian Regionaal Development; 28.001, Coastal Plains Regional Economic Development; 38.001, Four Corners Regional Economic Development; 48.001, New England Regional Economic Development; 52.001; Ozarks Regional Economic Development; 63.001, Upper Great Lakes Regional Economic Development; 75.001, Old West Regional Economic Development; 76.001, Pacific Northwest Regional Economic Development.

OMB *Catalogue*, p. 86.

10.418 WATER AND WASTE DISPOSAL SYSTEMS FOR RURAL COMMUNITIES

FEDERAL AGENCY: FARMERS HOME ADMINISTRATION, DEPARTMENT OF AGRICULTURE

AUTHORIZATION: Consolidated Farm and Rural Development Act, Section 306; Public Law 92-419; 7 U.S.C. 1926.

OBJECTIVES: To provide basic human amenities, alleviate health hazards and promote the orderly growth of the rural areas of the Nation by meeting the need for new and improved rural water and waste disposal systems.

TYPES OF ASSISTANCE: Guaranteed/Insured Loans; Project Grants.

USES AND USE RESTRICTIONS: Funds may be used for the installation, repair, improvement, or expansion of a rural water system including distribution lines, well, pumping facilities and costs related thereto. The installation, repair, improvement, or expansion of a rural waste disposal system including the collection, and treatment of sanitary, storm, and solid wastes. JOINT FUNDING: This program is considered particularly suitable (eligible) for joint funding with other closely related Federal financial assistance programs in accordance with the provisions of OMB Circular No. A-111. For programs that are not identified as particularly suitable or eligible for joint funding, applicant may consult the headquarters or field office of the appropriate funding agency for further information on statutory or other restrictions involved.

ELIGIBILITY REQUIREMENTS:

Applicant Eligibility: Municipalities, counties, and other political subdivisions of a State, such as districts and authorities; associations, cooperatives, and corporations operated on a not-for-profit basis; and Indian tribes on Federal and State reservations and other Federally recognized Indian tribes. Facilities shall primarily serve rural residents. The service area shall not include any area in any city or town having a population in excess of 10,000 inhabitants according to the latest decennial census of the United States. The applicant must: (1) be unable to finance the proposed project from its own resources or through commercial credit at reasonable rates and terms, and (2) have the legal authority necessary for constructing, operating, and maintaining the proposed facility or service, and for obtaining, giving security for, and repaying the proposed loan. Plans and specifications must be developed to comply with State and local health and pollution regulations and other requirements. Grants are made only when necessary to reduce the average annual residential user charges to a reasonable level. Normally, grants are considered only when the debt service portion of the average annual residential user cost exceeds 1 percent of the median income for the area to be served.

Beneficiary Eligibility: Primarily rural residents in eligible applicant areas as set out above.

Credentials/Documentation: Evidence of legal capacity, economic feasibility and financial responsibility relative to the activity for which assistance is requested. Costs will be determined in accordance with FMC 74-4 for State and local governments.

APPLICATION AND AWARD PROCESS:

Preapplication Coordination: Applications should be reviewed under procedures in Part I of OMB Circular No. A-95 (revised). The standard application forms as furnished by the Federal agency and required by FMC 74-7 must be used for this program. An environmental impact assessment and environmental impact statement are required for this program.

Application Procedure: Preapplication Form AD-621 and Application Form AD-624 are filed at the county FmHA office from which assistance may be obtained.

Award Procedure: The State Director is the loan approval official. Notification of grant or loan award must be made to the designated State Central Information Reception Agency in accordance with Treasury Circular 1082.

Deadlines: None.

Range of Approval/Disapproval Time: 30 to 90 days.

Appeals: If an application is rejected, the reasons for rejection are fully stated. The applicant may request a review of this decision from the Administrator of FmHA.

Renewals: Not applicable.

ASSISTANCE CONSIDERATIONS:

Formula and Matching Requirements: Funds are allocated to states based upon rural population and income; No requirement for matching funds.

Length and Time Phasing of Assistance: A time limitation is not specified for the use of FmHA loan or grant funds; however, it is anticipated that such funds will not be awarded until it has been determined that all FmHA requirements can be met and the project can be completed on a timely basis. Advances of funds will be made only as needed to cover expenses for a 30-day period.

POST ASSISTANCE REQUIREMENTS:

Reports: Quarterly and annual progress reports are to be made to the FmHA county supervisor.

Audits: Biennial audits are required when the annual gross facility income exceeds $100,000, or in accordance with state statutes or regulations.

Records: Records and accounts are required to reflect the operations of the project.

FINANCIAL INFORMATION:

Account Identification: (Loans) 12-4155-0-3-452; (Grants) 12-2066-0-1-451.

Obligations: (Loans) FY 76 $442,641,834; TQ $144,857,083; FY 77 est $600,000,000; and FY 78 est $600,000,000. (Grants) FY 76 $146,888,060; TQ $76,894,100; FY 77 est $266,751,867; and FY 78 est $200,000,000.

Range and Average of Financial Assistance: (Loans) $50,000 to $20,000,000; $360,000; (Grants) $5,000 to $1,000,000; $200,000.

PROGRAM ACCOMPLISHMENTS: In fiscal year 1976, 1,245 loans and 674 grants were made. Approximately 1,600 loans and 1,160 grants will be made in fiscal year 1977. It is estimated that 1,519 loans will be made in fiscal year 1978.

REGULATIONS, GUIDELINES, AND LITERATURE: 7 CFR 1823 (Loans)-Section 1823.1 thru 1823.48, (Grants) 1823.471 thru 1823.477; Community Facility Loans, PA-1100.

INFORMATION CONTACTS:

Regional or Local Office: Consult your local telephone directory for FmHA county office number. If no listing, get in touch with appropriate FmHA State office listed in the appendix.

Headquarters Office: Administrator, Farmers Home Administration, Department of Agriculture, Washington, DC 20250. Telephone: (202) 447-7967.

RELATED PROGRAMS: 13.229, Indian Health Services-Sanitation Management Development Program; 66.418, Construction Grants for Wastewater Treatment Works.

OMB *Catalogue*, p. 32.

10.423 COMMUNITY FACILITIES LOANS

FEDERAL AGENCY: FARMERS HOME ADMINISTRATION, DEPARTMENT OF AGRICULTURE

AUTHORIZATION: Consolidated Farm and Rural Development Act, Section 306; Public Law 92-419; 7 U.S.C. 1926.

OBJECTIVES: To construct, enlarge, extend, or otherwise improve community facilities providing essential services to rural residents.

TYPES OF ASSISTANCE: Guaranteed/Insured loans.

USES AND USE RESTRICTIONS: Community facilities include but are not limited to those providing or supporting overall community development such as fire and rescue services, transportation, traffic control, community, social, cultural, health and recreational benefits: industrial and business development. All facilities financed in whole or in part with FMHA Funds shall be for public use.

ELIGIBILITY REQUIREMENTS:

Applicant Eligibility: Public and quasi-public bodies and associations including corporations, Indian tribes on Federal and State reservations and other federally recognized Indian tribes and existing private corporations which (1) are operated on a not-for-profit basis, (2) have or will have the legal authority necessary for constructing, operating, and maintaining the proposed facility or service and for obtaining, giving security for, and repaying the loan, and (3) are unable to finance the proposed project from its own resources or through commercial credit at reasonable rates and terms.

Beneficiary Eligibility: Eligibility includes public and quasi-public bodies and associations including corporations, Indian tribes on Federal and State reservations and other federally recognized Indian tribes and existing private corporations which are operated on a not-for-profit basis which serve residents of open country and rural towns and villages of not more than 10,000 population.

Credentials/Documentation: Evidence of legal capacity, economic

feasibility and financial responsibility relative to the activity for which assistance is requested.

APPLICATION AND AWARD PROCESS:

Preapplication Coordination: Applications should be reviewed under procedures in Part I of OMB Circular No. A-95 (revised). The standard application forms as furnished by the Federal agency and required by FMC 74-7 must be used for this program. An environmental impact assesment and an environmental impact statement are required for this program. An informal preapplication conference is recommended.

Application Procedure: Preapplication Form AD-621 and Application Form AD-624 are filed at the local FmHA County Office from which assistance may be obtained.

Award Procedure: After the application has been reviewed by the country supervisor, it is forwarded to the FmHA State Director for review and final approval. Following approval, payment authorization is forwarded to the National Finance Office which issues the check to the County FmHA Supervisor for final delivery. Notification of the award must be made to the designated State Central Information Reception Agency in Accordance with Treasury Circular 1082.

Deadlines: None.

Range of Approval/Disapproval Time: 30 to 90 days.

Appeals: If an application is rejected, the reasons for rejection are fully stated. The applicant may request a review of the decision from the Admininstrator of FmHA.

Renewals: Not applicable.

ASSISTANCE CONSIDERATIONS:

Formula and Matching Requirements: Matching funds are not required, but may be used in connection with the funds provided from the applicant or other sources. Funds are allocated to states based upon rural population and income.

Length and Time Phasing of Assistance: Loans may be scheduled over a period up to 40 years.

POST ASSISTANCE REQUIREMENTS:

Reports: Annual reports are made to FmHA. Each borrower will monitor and report to FmHA on actual performance during the construction of each project financed, or to be financed in whole or in part with FmHA loans funds.

Audits: Requirement for audits are established with the applicant by FmHA with annual audits as needed.

Records: The borrower must maintain adequate records and accounts of the operation of the facility developed.

FINANCIAL INFORMATION:

Account Identification: 12-4155-0-3-452.

Obligations: (Loans) FY 76 $170,200,600; TQ est $79,795,000; FY 77 est $200,000,000; and FY 78 est $200,000,000.

Range and Average of Financial Assistance: $5,000 to $18,000,000; $542,000.

PROGRAM ACCOMPLISHMENTS: In fiscal year 1976, 332 loans were made. It is estimated that 370 loans will be made in fiscal year 1977 and that 351 loans will be made in fiscal year 1978.

REGULATIONS, GUIDELINES, AND LITERATURE: 7 CFR 1823 Sections 1823.1 -1823.48; Community Facility Loans, PA-1100.

INFORMATION CONTACTS:

Regional or Local Office: Consult your local telephone directory for FmHA County office number. If no listing, get in touch with appropriate FmHA State office listed in appendix.

Headquarters Office: Administrator, Farmers Home Administration, Department of Agriculture, Washington, DC 20250. Telephone: (202) 447-7967 (Use same 7-digit number for FTS).

RELATED PROGRAMS: 10.422, Business and Industrial Loans; 10.424, Industrial Development Grants; 10.500, Cooperative Extension Service; 10.662, Rural Community Fire Protection; 15.124, Indian Loans-Economic Development.

OMB *Catalogue*, p. 36.

14.218 COMMUNITY DEVELOPMENT BLOCK GRANTS/ENTITLEMENT GRANTS

FEDERAL AGENCY: COMMUNITY PLANNING AND DEVELOPMENT, DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

AUTHORIZATION: Title I of the Housing and Community Development Act of 1974, Public Law 93-383, 42 U.S.C. 5301-5317.

OBJECTIVES: To develop viable urban communities, including decent housing and a suitable living environment, and expand economic opportunities, principally for persons of low and moderate income.

TYPES OF ASSISTANCE: Formula Grants.

USES AND USE RESTRICTIONS: The Block Grant Program consolidates seven former community development-type categorical programs, including Urban Renewal, Model Cities, Neighborhood Facilities, Open Space Land, Historical Preservation, Urban Beautification, the Basic Water and Sewer Facilities Program, Public Facilities Loans, and Rehabilitation Loans. Generally most activities previously eligible under the consolidated categorical programs are able to be performed under this program, i.e., acquisition, construction of certain public works, facilities and improvements, clearance, housing rehabilitation. Code enforcement, relocation payments and assistance, administrative expenses, and completing existing urban renewal projects. In addition, block grant funds to pay for certain public services not otherwise available but which are necessary or appropriate to support other block grant activities. Communities are restricted from constructing or rehabilitating public facilities for the general conduct of government and certain community wide facilities, i.e., stadiums, sports arenas, cultural centers, central libraries, convention centers, and from underwriting the cost of constructing new housing, or of making housing allowance or other income maintenance - type payments.

ELIGIBILITY REQUIREMENTS:

Applicant Eligibility: Cities in SMSA's with populations in excess of 50,000, "urban counties," as defined in the Act, and cities with populations of under 50,000 which are central cities in SMSA's are all entitled to receive amounts of funds determined by a statutory formula. In addition, localities which received grants under the urban renewal and model cities programs will receive "hold harmless' grants based on their level of prior participation in those programs.

Beneficiary Eligibility: See applicant eligibility.

Credentials/Documentation: Costs will be determined in accordance with FMC 74-4 for State and local governments.

APPLICATION AND AWARD PROCESS:

Preapplication Coordination: In preparing an application, environmental factors must be taken into account, and an activity requiring an environmental review must be reviewed before funds for that activity can be released. An environmental impact statement is necessary for this program. Applications should be reviewed under procedures in Part I of OMB Circular No. A-95 (revised).

Application Procedure: Localities file annual applications, Standard Form SF 424, for their entitlement funding containing (1) a summary of a 3 year community development plan, (2) a 1 year community development program, (3) a budget, and (4) a housing assistance plan. In addition a series of certifications regarding other Federal requirements are part of the application.

Award Procedure: Applications are approved in the HUD Area Office. Notification of grant award must be made to the designated State Central Information Reception Agency in accordance with Treasury Circular 1082.

Deadlines: Applications for fiscal year 1977 must be submitted according to the schedule in the published regulations.

Range of Approval/Disapproval Time: Within 75 days.

Appeals: None.

Renewals: A new application must be submitted each year.

ASSISTANCE CONSIDERATIONS:

Formula and Matching Requirements: Entitlement formula is based on population, housing overcrowding and poverty level. No matching requirement.

Length and Time Phasing of Assistance: Assistance is for an annual program of activities but activities may be continued beyond one year until completed.

POST ASSISTANCE REQUIREMENTS:

Reports: Annual Performance Report and Financial Reports in accordance with FMC 74-7.

Audits: Annual audit.

Records: The applicant must maintain records with regard to financial management, citizen participation, relocation, other resources, acquisition, equal opportunity, environmental impact, labor standards and any other requirement set forth in regulations.

FINANCIAL INFORMATION:

Account Identification: 86-0162-0-1-451.

Obligations: (Grants) FY 76 $2,075,641,000; TQ $394,870,000; FY 77 est $2,831,433,000; and FY 78 est $2,812,300,000.

Range and Average of Financial Assistance: Determined by Formula.

PROGRAM ACCOMPLISHMENTS: As of December 31, 1976 there were 1,330 active grants.

REGULATIONS, GUIDELINES, AND LITERATURE: Administrative Regulations for Community Development Block Grants, 24 CFR 570.

INFORMATION CONTACTS:

Regional or Local Office: Contact appropriate HUD Area Office (or Regional Office in Region VIII) listed in the appendix.

Headquarters Office: Community Planning and Development, 451 7th Street, S.W., Washington, DC 20410.

RELATED PROGRAMS: 14.219, Community Development Block Grants/Discretionary Grants.

OMB *Catalogue*, p. 453.

14.219 COMMUNITY DEVELOPMENT BLOCK GRANTS/DISCRETIONARY GRANTS

FEDERAL AGENCY: COMMUNITY PLANNING AND DEVELOPMENT, DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

AUTHORIZATION: Title I of the Housing and Community Development Act of 1974, Public Law 93-383, 42 U.S.C. 5301 - 5317.

OBJECTIVES: To develop viable urban communities including decent housing and a suitable living environment, and expand economic opportunities, principally for persons of low and moderate income.

TYPES OF ASSISTANCE: Project Grants.

USES AND USE RESTRICTIONS: Generally, as in the case of entitlement grants, most activity previously eligible under the categorical program consolidated under the Act, and defined by the statute and regulations may be carried out, i.e. acquisition, rehabilitation or construction of certain public works facilities and improvements, clearance, housing rehabilitation, code enforcement, relocation payments and assistance, administrative expenses, and completing existing urban renewal projects. Communities are restricted, from constructing or rehabilitating public facilities for the general conduct of government and certain community wide facilities, i.e. central libraries, stadiums, sports arenas, cultural centers, convention centers; and from underwriting the cost of constructing new housing or of making housing allowance or other income maintenance -- type payments. JOINT FUNDING: This program is considered particularly suitable (eligible) for joint funding with closely related Federal financial assistance programs in accordance with the provisions of OMB Circular No. A-111. For programs that are not identified as particularly suitable or eligible for joint funding, applicant may consult the headquarters or field office of the appropriate funding agency for further information on statutory or other restrictions involved.

ELIGIBILITY REQUIREMENTS:

Applicant Eligibility: Applicant may be eligible for grants from one or more of the three sources of discretionary funds: 1. General Purpose Fund: Funds remaining after entitlement and hold harmless obligations are met: applicants are states and units of general local government, except for metropolitan cities and urban counties. 2. Secretary's Fund: Two percent of the total funds each year is set aside in a national discretionary fund for grants to communities; to assist "new communities;" to carry out area wide housing and community development programs; in Guam, The Virgin Islands, American Samoa, and the Trust Territory of the Pacific Islands; to meet emergency community development needs caused by federally recognized disasters; to carry out innovative projects; and to correct inequities arising from the formula allocation. 3. Urgent Needs Fund: a special fund intended to help in bridging the gaps between old categorical programs and the new block grants.

Beneficiary Eligibility: See applicant eligibility.

Credentials/Documentation: Costs will be determined in accordance with FMC 74-4 for State and local governments.

APPLICATION AND AWARD PROCESS:

Preapplication Coordination: In preparing an application, environmental factors must be taken into account, and an activity requiring an environmental review must be reviewed before funds for that activity can be released. An environmental impact statement is necessary for this program. Applications should be reviewed under procedures in Part I of OMB Circular No. A-95 (revised). The standard application forms as furnished by the agency and required by FMC 74-7 must be used for this program.

Application Procedure: General Purpose Metropolitan and Nonmetropolitan Fund: Applicant files a preapplication and if the applicant rates high against the criteria a full application is requested. Secretary's fund and urgent need fund: Applicant files the basic entitlement application with appropriate modifications.

Award Procedure: Applicants are advised of outcome by the Area Office. Notification of grant award must be made to the designated State Central Information Reception Agency in accordance with Treasury Circular 1082.

Deadlines: Applications for fiscal year 1977 must be submitted according to the schedule in the published regulations.

Range of Approval/Disapproval Time: Although not required by Statute, notification will be attempted within 75 days.

Appeals: None.

Renewals: There are no automatic renewals. A complete new application process must be undertaken.

ASSISTANCE CONSIDERATIONS:

Formula and Matching Requirements: None.

Length and Time Phasing of Assistance: Assistance is for an annual program but activities may be continued beyond 1 year until completed.

POST ASSISTANCE REQUIREMENTS:

Reports: Annual Performance Report and Financial Reports in accordance with FMC 74-7.

Audits: Annual audit.

Records: All information on grants must be kept.

FINANCIAL INFORMATION:

Account Identification: 86-0162-0-1-451.

Obligations: (General purpose discretionary) FY 76 $244,191,000; TQ $222,592,000; FY 77 est $532,058,000; and FY 78 est $625,700,000; (Secretary's fund) FY 76 $27,486,000; TQ $12,418,000; FY 77 est $92,762,000; and FY 78 est $62,000,000. (Urgent need) FY 76 $61,176,000; TQ $23,146,000; FY 77 est $110,218,000; and FY 78 est $100,000,000.

Range and Average of Financial Assistance: 1st Year of program.

PROGRAM ACCOMPLISHMENTS: As of December 31, 1976, 1,861 applictions for general purpose discretionary funds were approved.

REGULATIONS, GUIDELINES, AND LITERATURE: Administrative Regulations for Community Development Block Grants, 24 CFR 570.

INFORMATION CONTACTS:

Regional or Local Office: Contact appropriate HUD Area Office (or Regional Office in Region VIII) listed in the appendix.

Headquarters Office: Community Planning and Development, 451 7th Street, S.W., Washington, DC 20410.

RELATED PROGRAMS: 14.203, Comprehensive Planning Assistance; 14.218, Community Development Block Grants/Entitlement Grants.

OMB *Catalogue*, p. 454.

APPENDIX G: FEDERAL TECHNICAL ASSISTANCE FOR WATER SUPPLY DEVELOPMENT

This appendix contains information concerning federal technical assistance for water supply development. The Drinking Water Supply-Technical Assistance program utilizes two types of technical assistance: advisory services/ counseling and the dissemination of technical information. Advisory services and counseling programs provide federal specialists to consult with, advise, or counsel communities or individuals through conferences, workshops, or personal contacts. This approach may involve the use of published information in a secondary capacity. The dissemination of technical information is facilitated by the publication and distribution of information or data of a specialized technical nature, frequently through clearinghouses or libraries; it does not include conventional public information services designed for the general public.

66.425 DRINKING WATER SUPPLY–TECHNICAL ASSISTANCE

FEDERAL AGENCY: OFFICE OF WATER AND HAZARDOUS MATERIALS, ENVIRONMENTAL PROTECTION AGENCY

AUTHORIZATION: Public Health Service Act, as amended, Sections 301, 311, and 361; Title XIV Public Law 78-410; Public Law 93-523; 42 U.S.C. 201, 241, 243, 264, and 300f.

OBJECTIVES: To assure that water supply systems serving the public meet minimum national standards for the protection of public health.

TYPES OF ASSISTANCE: Advisory Services and Counseling; Dissemination of Technical Information.

USES AND USE RESTRICTIONS: Assistance is available to any State and any utility which coordinates their request through a State. Technical assistance staff members commonly work through the State agency to provide assistance.

ELIGIBILITY REQUIREMENTS:

Applicant Eligibility: State and local water supply regulatory agencies and public water supply operators or officials.

Beneficiary Eligibility: The general public served by a water supply.

Credentials/Documentation: None.

APPLICATION AND AWARD PROCESS:

Preapplication Coordination: None.

Application Procedure: Apply to regional offices of EPA; or to EPA headquarters, Office of Water Supply, Office of Water and Hazardous Materials, Washington, DC 20460. (Verbal requests are considered).

Award Procedure: Not applicable.

Deadlines: Not applicable.

Range of Approval/Disapproval Time: Not applicable.

Appeals: Not applicable.

Renewals: Not applicable.

ASSISTANCE CONSIDERATIONS:

Formula and Matching Requirements: Not applicable.

Length and Time Phasing of Assistance: Not applicable.

POST ASSISTANCE REQUIREMENTS:

Reports: Not applicable.

Audits: Not applicable.

Records: Not applicable.

FINANCIAL INFORMATION:

Account Identification: 68-0108-0-1-304.

Obligations: (Salaries and expenses) FY 76 $6,135,000; TQ $4,960,000; FY 77 est $10,134,000; and FY 78 est $11,300,000.

Range and Average of Financial Assistance: Not applicable.

PROGRAM ACCOMPLISHMENTS: During fiscal years 1976 and 1977, technical assistance was provided to all states and, through states, to a significant number of utilities. Under the Safe Drinking Water Act (PL 93-523) enacted December 16, 1974, (1) The interim primary drinking water regulations were promulgated; (2) the annual primary drinking water regulations were proposed; (2) the annual report was transmitted to Congress; (3) State program regulations were promulgated; and (4) underground injection control regulations were proposed.

REGULATIONS, GUIDELINES, AND LITERATURE: A Guide to the Interstate Carrier Water Supply Certification Program, June 21, 1971; Manual for Evaluating Public Water Supplies; Manual of Individual Water Supply Systems; Water Supply and Plumbing Cross-Connections; Manual for the Evaluation of a State Drinking Water Supply Program; various papers and reports produced by the staff; National Interim primary drinking Water Regulations, (40 CFR 141); grants for State Public Water System Supervision Programs, (40 CFR 35.6); Drinking Water Regulations Implementation (40 CFR 142).

INFORMATION CONTACTS:

Regional or Local Office: Contact appropriate EPA Regional Administrator listed in appendix.

Headquarters Office: Peter Bengston, Office of Water Supply, Office of Water and Hazardous Materials, Environmental Protection Agency, Washington, DC 20460. Telephone: (202) 426-3983 (Use same 7-digit number for FTS).

RELATED PROGRAMS: 66.423, Water Quality and Pollution Control Information System-Orientation Training Seminars, Data and Monitoring Publications; 66.432, State Public Water System Supervision Program Grants; 66.433, State Underground Water Source Protection Program Grants.

Source: Office of Management and Budget, Executive Office of the President, *Catalogue of Federal Domestic Assistance* (Washington, D.C.: U.S. Government Printing Office, 1977), p. 821.

APPENDIX H: MODES OF DATA PRESENTATION

Public presentations can be among the most effective means of communicating a water supply development proposal. This appendix provides a summary of advantages, disadvantages, and cost estimates of various modes of data presentation. All cost figures assume purchased equipment; presentation costs can be significantly reduced through the use of rented or borrowed equipment, amateur photographers, and journalism students.

Mode of Presentation	*Advantages*	*Disadvantages*	*Equipment Needed*
Flip Charts	Requires no technical expertise, no equipment; inexpensive.	Harder to keep the attention of audience; must have prepared talk to explain and describe charts.	Chart paper, easel.
Tape-slide Presentation	Good for absorbing visual identification, concepts and rules not governed by movement; sound and pictures can be correlated; sequence of pictures can easily be changed; slides can be used for other purposes.	More equipment; more expensive equipment needed; motion cannot be shown easily.	Automatic slide projectors, camera, tape recorder, viewing screens. Cost estimates: projector @ $150; stereo-tape recorder @ $250; camera @ $200-$300.
Printed Booklet	Can be used for small or large groups; allows use of photographs, charts, graphs; can be absorbed at the convenience of recipient; can be mailed or handed out.	Lacks emotional impact of media presentation; cannot show motion and has no sound.	
Overhead Projection	Good for speaking in front of a group; can use with lights on; the most inexpensive projection technique.	Cannot use photographs; need certain type of Xerox machine for transparencies.	Transparencies (available from Xerox); overhead projector @ $100 special marking pens for coloring transparencies.
16mm Sound Film	Good for auditorium or classroom viewing; good for presenting principles, concepts and rules; sound can be synchronized to action.	Expensive; very hard to revise; not suited to small groups.	Camera, 16mm projector, tape recorder. If professional filmmaker is employed, cost will be $800/min. for color and $400/min. for black and white.
Super 8 mm Magnetic Sound Film	Can use amateur equipment; good for classrooms and small groups; good for presenting principles, concepts and rules.	Hard to edit; not suitable for television, except cable television; hard to find sound film projectors.	Super 8 mm camera, Super 8 mm magnetic sound projector, tape recorder.

Source: Adapted from Godfrey, Jan and Weaver, Jim, *Community Indicators For Your City*, Austin, Texas: Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin, 1975.

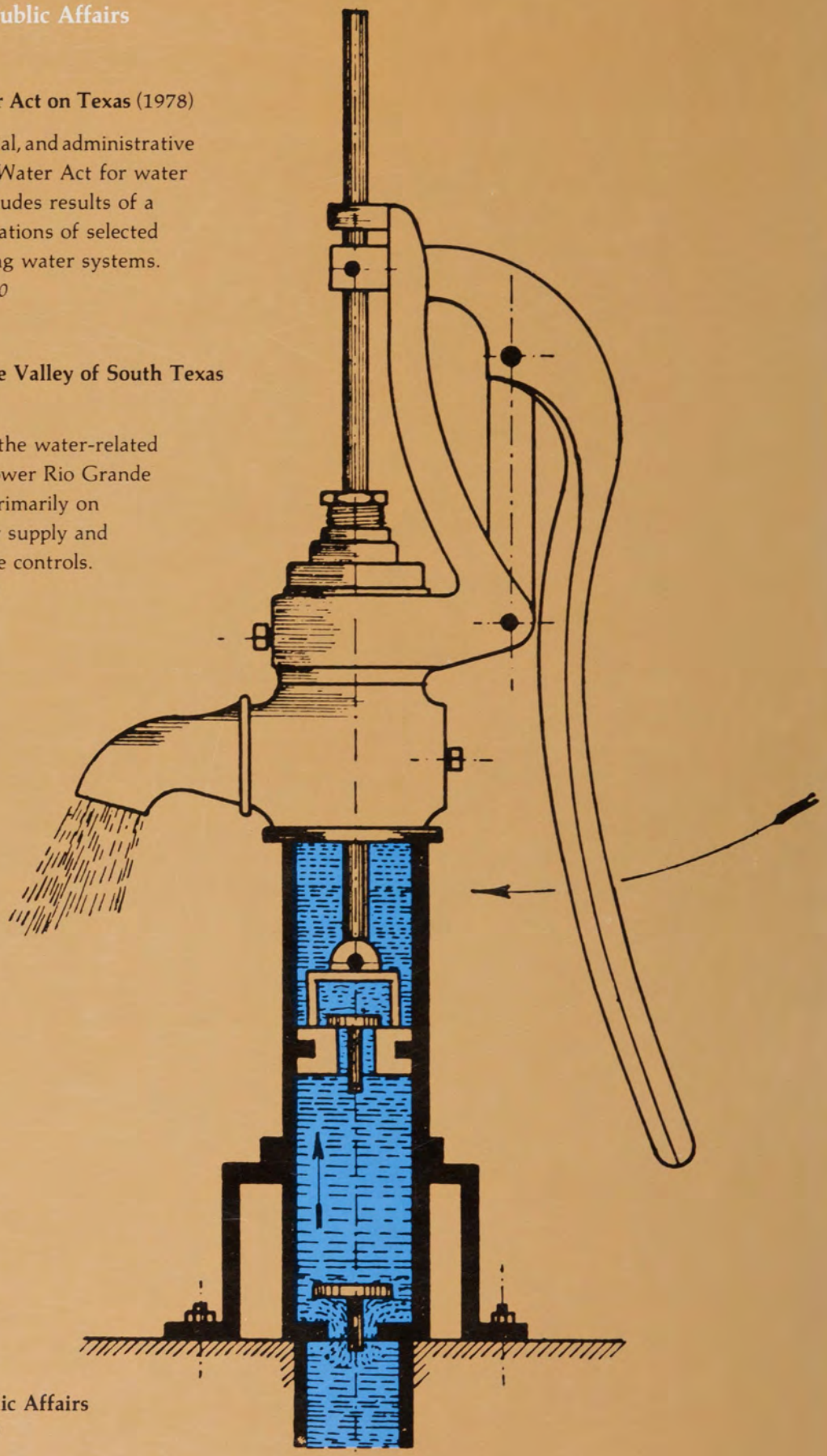
Water-related publications of the Lyndon B. Johnson School of Public Affairs

Impact of the Safe Drinking Water Act on Texas (1978)

Explores the legal, technical, financial, and administrative implications of the Safe Drinking Water Act for water suppliers in Texas. The report includes results of a survey of the attitudes and expectations of selected operators and managers of drinking water systems.
8½"x11", 189 pages, paperbound, $4.00

Colonias in the Lower Rio Grande Valley of South Texas (1977)

Summarizes research findings on the water-related problems of the colonias of the Lower Rio Grande Valley of South Texas, focusing primarily on institutional alternatives for water supply and sewage treatment, and on land use controls.
8½"x11", 25 pages, paperbound, $3.00



Office of Publications
Lyndon B. Johnson School of Public Affairs
The University of Texas at Austin
Drawer Y, University Station
Austin, Texas 78712 (512) 471-4962